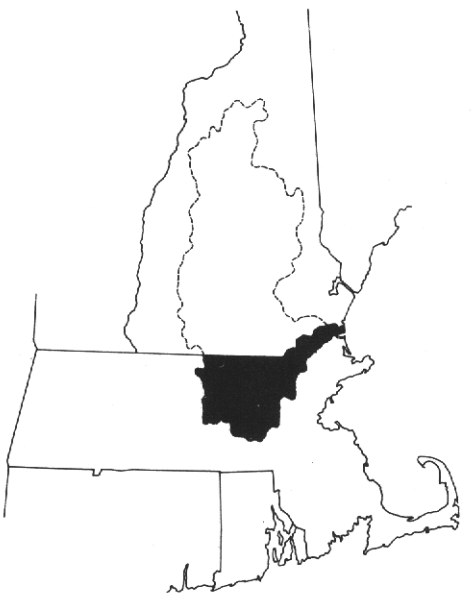
MERRIMACK WASTEWATER MANAGEMENT

key to a clean river

APPENDIX IV-A

SOCIO-ECONOMIC IMPACTS



NORTHEASTERN UNITED STATES WATER SUPPLY STUDY

NOVEMBER 1974

MERRIMACK WASTEWATER MANAGEMENT
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MERRIMACK WASTEWATER MANAGEMENT

(KEY TO A CLEAN RIVER)

APPENDIX IV-A

SOCIO-ECONOMIC IMPACT ANALYSIS

of Alternative Wastewater Management Systems in the Massachusetts Merrimack River Basin

November 1974

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I. INTRODUCTION

The purpose of the present report is to assess the socio-economic impacts of alternative wastewater management systems proposed by the Corps of Engineers, New England Division, for the Merrimack River Basin Wastewater Management Study. The alternatives have been designed to comply with the 1977, 1983 and 1985 goals and requirements of the Federal Water Pollution Control Act Amendments of 1972. This socio-economic impact assessment, along with independent assessments done of biologic, terrestrial, aesthetic, cultural and hygienic impacts, is aimed at aiding in the ultimate selection of the cost-effective alternative as judged by the overall goals and interests of communities and governmental units involved.

Six initial engineering alternatives were developed for the Merrimack Study by Anderson-Nichols Inc. The six alternatives differed principally as to whether they were water or land-oriented in terms of ultimate disposal of wastes, and for the water-oriented areas, as to whether they were more regionalized or decentralized. The overall study was limited, by Congressional Resolution, to the mainstem portion of the Merrimack River in Massachusetts.

The various impact assessments were then assembled in draft form by the Corps of Engineers, and an overall cost-effective alternative was fashioned out of components of the initial six alternatives, based on a conscious process of trading off anticipated benefits and disbenefits.

Thus, for a complete understanding of the analytic context within which this socio-economic impact assessment component was developed, the reader should refer to the entire Merrimack River Basin Wastewater Management Study. That overall document contains the needed additional information on the content of the engineering alternatives considered, as well as the results of the other impact assessments which were done.

II. METHODOLOGY FOR IMPACT ASSESSMENT

Step 1. Impact Identification

A. Impact Identification Process

The impact identification process utilizes a matrix (shown on the following page), the rows of which are plan actions, or components of a particular engineering alternative, and the columns of which are impact categories, or the socio-economic features of the study area that may be affected by the various plan actions. The matrix thus provides a checklist for systematically reviewing potential impacts.

The procedure for impact identification consisted of reviewing each plan action of an alternative and judging whether or not the action could be expected to cause a major change in any of the impact categories.

Inputs to impact identification were (1) the proposed plan actions of each engineering alternative and (2) forecasts of economic, social and environmental conditions. These forecasts were extrapolations of conditions that would prevail if no plan actions were taken. Outputs are the changes that can be expected if the plan actions are taken.

B. Relationship between Impact Identification and the Planning Process

Impact identification has proceeded in parallel with the process of developing engineering alternatives. The two Regional Planning Agencies in the study area--the Merrimack Valley Planning Commission and the Northern Middlesex Area Commission--participated in the design of the alternatives, providing input based on their on-going public participation activities and their knowledge of the study area. It is expected that further public participation activities will continue to influence future refinement and reformulation of alternatives.

Step 2. Impact Analysis

A. Impact Analysis Process

Prioritization of impacts to be analyzed in depth was based on technical judgment of Abt Associates and Corps of Engineers staff, with major input from the staffs of the two Regional Planning Agencies. Once the impacts were prioritized, relevant data for each were collected and analyzed, then the assumptions necessitated by the available data were

PLAN ACTIONS / IMPACT CATEGORIES		Agriculture	Commercial Fisheries	Service Sector	Land Use	Housing	Transportation	Recreation	Employment & Manufacturing	Personal Income & Wealth	Municipal Finance	Municipal Services
Objectives	Water Quality											
By-Products	Water Quantity											
	Water Supply											
	Collection System											
	Treatment Residuals											
Short-Term Requirements	Construction											
Long-Term Requirements	Land Modification											
	Capital Cost Funding											
	Private Abatement Actions											
	Operations											

TABLE 1: IMPACT IDENTIFICATION MATRIX

made, and finally impacts were estimated, in terms of direct and indirect, and short-term and long-term changes.

B. The Baseline Concept

The impact analysis examines the socio-economic conditions that are projected to exist at two specified future times (1990 and 2020), as a result of implementing alternative wastewater management systems that would be installed in 1983 and 1985. The conditions that will result from implementing the alternatives are measured as changes caused, either directly or indirectly, by the features of each alternative. In order to measure these changes, and derive the percentage difference in conditions that is made by implementing an alternative, we must project the socio-economic conditions that would exist in 1990 and 2020 in the absence of any of the proposed alternatives. This "without project" set of socio-economic conditions is referred to throughout the analysis as the baseline for the impact assessment.

The baseline that is used in the present assessment is the Environmental Protection Agency's State Implementation Program, which calls for secondary wastewater treatment (SWT) systems to be installed throughout the study area by 1977. The EPA Program forms the baseline for measuring changes because it constitutes the "without project" situation that will be obtained in the future if none of the Corps of Engineers alternatives for advanced wastewater treatment (AWT) is implemented. By comparing in this way the results of implementing AWT systems vs. SWT systems in the study area, it is possible to measure the changes made by the AWT alternatives as percentages of the baseline conditions, which is the only meaningful measure of the magnitude of impacts.

Having set forth the ideal structure for the present impact assessment, we must now explain some departures from that methodology. Estimation of expected impacts strictly in terms of changes from the baseline was not possible in the case of every impact addressed in the study. Measurement of changes from the baseline was infeasible in some instances because the plan actions of the EPA State Program were not specified in a form that permitted straight comparison with the plan actions of the AWT alternatives, or in other instances not available at all. Rather than omit consideration of an impact where baseline data were lacking, the impact was addressed in general terms describing the issues involved and probable parameters of the effect.

Estimates of expected impacts have been quantified wherever justified by the data available for the analysis. It must be recognized that economic analysis should be applied only when the results improve the information necessary for decision-making. Quantification of impacts was rejected when it could only be based on unreliable assumptions and techniques that would merely create an illusion of precise measurement.

III. SUMMARY OF FINDINGS AND CONCLUSIONS

A. Overview

The general findings of the analysis of socio-economic impacts presented here follow a fairly straightforward logic. The principal questions at issue in the Merrimack River Wastewater Management Study, from a socio-economic standpoint, are:

1. How much do the alternative engineering solutions cost?
2. What are the benefits to be realized by these expenditures?
3. What risks or disbenefits are incurred as part of implementing the alternatives?

The cost question is answered in terms both of total dollar costs and likely impacts on individual municipal tax rates and operating budgets. The principal benefits discussed, other than public health, are those affecting recreation and commercial shell fishing. The risks covered are primarily those involving land use conflicts and loss of industrial jobs.

In the most general terms, the findings of the socio-economic impact analysis support the conclusion that the decentralized water-oriented alternatives (Alternatives 1 and 2) represent, on balance, the preferred approach to water quality management in the Merrimack basin.

Decentralization, although it requires a greater number of treatment plants, still involves the lowest total construction costs because of the absence of the longer interceptors. At the same time operations and maintenance (O&M) costs for the decentralization alternatives are roughly similar to those required for centralization and land application. Thus from an overall viewpoint the decentralization options are preferred.

In terms of benefits, improvements in water quality are fairly difficult to distinguish as among the engineering alternatives. The decentralized options avoid the large discharges associated with centralization of treatment. Land application would apparently produce even greater water quality improvements but is not preferred overall because of higher capital costs and potential land use conflicts (see below). Thus, both decentralization and land application involve potentially greater benefits to water recreationists than does centralization. A decentralized solution (Alternative 2) is definitely preferred in terms of benefiting commercial fishermen, because of the ocean outfall.

The decentralized alternatives avoid the long interceptors which cross areas where development is or may be unwanted. Again, land application also avoids the long interceptors but encounters ambivalence in local attitudes toward preservation of open space.

While some groups view land application as a means for heading off development of existing open lands, others see it as also foreclosing alternative future recreation uses. The potential for causing industrial job losses is tied directly to the total construction and O&M costs of the various alternatives. Since these costs are not dramatically different across alternatives, it is extremely difficult to distinguish among them regarding industrial impacts. Decentralized options entail fewer construction and O&M jobs than do the centralized ones, but the differences again are so small as to be insignificant in terms of ultimate preferences.

Table 2: SUMMARY OF FINDINGS AND CONCLUSIONS

MAJOR IMPACTS	PREFERENCE RANKING					
	1	2	3	4	5	6
Municipal Finance and Services	Alt. 2	Alt. 1	Alt. 4	Alt. 3	Alt. 5	Alt. 6
Recreation Opportunities	Alts. 5 & 6	Alt. 1	Alt. 2	Alt. 3	Alt. 4	
Commercial Fisheries	Alt. 2	Alts. 3 & 4	Alts. 5 & 6	Alt. 1		
Land Use	IMPACTS ARE TOWN-SPECIFIC; NO OVERALL RANKING POSSIBLE.					
Housing	MAJOR IMPACTS ARE CAUSED BY COLLECTION SYSTEMS, WHICH DO NOT DIFFER ACROSS THE ALTERNATIVES					
Manufacturing Employment	Alt. 2	Alt. 1	Alt. 4	Alt. 3	Alt. 5	Alt. 6
Construction Employment						
• MVPC	Alts. 3 & 4	Alts. 5 & 6	Alts. 1 & 2			
• NMAC	Alt. 3	Alt. 4	Alt. 5	Alt. 2	Alt. 1	
OTHER IMPACTS						
Agriculture						
• MVPC	Alt. 5	Alt. 6	Alts. 1-4			
• NMAC	Alt. 5	Alts. 1-4				
Transportation						
• MVPC	Alts. 1 & 2	Alts. 3-6				
• NMAC	Alts. 1 & 2	Alts. 3 & 4	Alt. 5			
Service Sector	IMPACTS ARE TOO DIVERSE AND INDIRECT TO WARRANT DIFFERENTIATION ACROSS ALTERNATIVES.					

B. MAJOR FINDINGS

1. Municipal Finance and Services

The capital cost and operations funding requirements of the proposed engineering alternatives will have significant impacts on local government finances in the Merrimack basin. Local property tax rates may have to be increased to cover the non-industrial portion of the local share of construction costs. Annual operating budgets will increase because of higher O&M costs, and this burden will have to be passed on to individual residents in the form of user charges. The tax rate increases under any of the alternatives vary mainly depending on (a) whether the particular town has to build a new collection system and (b) the extent to which the town has an industrial base over which to spread the local share costs. Sewer construction costs are exempt from local ceilings on bonded debt, so the major impact on other local services will come primarily from having to compete with higher annual O&M costs for a share of the town's operating budget.

Ranking of the Alternatives

The only reasonable basis for a preference ordering of the proposed engineering alternatives is total system cost. Since annual O&M costs are roughly similar under the six alternatives, the major cost differences are due to one-time construction and land acquisition costs. The decentralized alternatives are thus the lowest in cost, followed by the centralized options and then land application.

Rank	Alternative
1	2
2	1
3	4
4	3
5	5
6	6

2. Recreation

Recreation opportunities in the study area will be affected by two aspects of the proposed wastewater management alternatives: (1) to a minor extent by land modification, wherein land areas that are existing or potential recreation sites are proposed for treatment plant or effluent disposal sites; and (2) much more significantly, by specified objectives regarding the ultimate level of water quality to be achieved in the Merrimack River Basin.

- Land Modification

Five communities in the MVPC region (Salisbury, Rowley, Boxford, Georgetown and Merrimac) have recreation-oriented land that would be affected by proposed facilities, and three communities in the NMAC region (Chelmsford, Pepperell and Westford). The impact of land modification on recreation opportunities is not, however, expected to be significant, in terms of either benefits or costs, for the following reasons: (a) the bulk of the acreage involved is associated with spray irrigation sites, which are not incompatible with the planned open-space use of the areas affected; (b) rapid infiltration sites would in no case involve a large proportion of available open-space in a community; their impact would be essentially neutral in that small multiple-use opportunities might be provided on the one hand, but some potential users might consider the rapid infiltration sites unattractive for recreational use; (c) treatment plant sites consume a relatively small amount of acreage in what are generally large open space areas, and should therefore have a negligible impact on the supply of available recreation-oriented land.

Ranking of Alternatives

Alternatives 5 and 6 are those which propose spray irrigation and rapid infiltration facilities. Alternatives which propose treatment plants in designated open space areas are 1-6 in Salisbury, 1, 5 & 6 in Rowley, and 1 & 5 in Chelmsford (North). The alternatives are not ranked on the basis of their impacts from land modification as this effect is considered to be neutral.

- Water Quality

Potentially, implementation of advanced wastewater treatment systems in the Merrimack River Basin could have a significant impact on recreation opportunities and revenues in the study area. Opportunities for participation in water-quality dependent activities such as swimming, sport fishing and water-skiing could increase enormously and bring major economic benefits. However, the extent of improvement in water quality in the basin cannot be projected with certainty until additional factors are accounted for, such as non-point sources of pollution, treatment plant reliability, and enforcement of permit requirements.

Ranking of Alternatives

Although water quality changes cannot be precisely estimated, the findings of the biologic assessment for this study are the most useful basis available for ranking the relative recreation benefits of the different proposed alternatives. According to the biologic assessment, the land oriented alternatives, 5 and 6 are most preferable in terms of protecting water quality. Following in decreasing order of preference are Alternatives 1, 2, 3 & 4; that is, among the water-oriented alternatives, decentralization is preferable to centralization

and regionalization.

3. Commercial Fisheries

Changes in the value of commercial fishing industry in the Merrimack River estuary that might result from implementation of any of the proposed alternatives can be projected with only very limited confidence because of uncertainty regarding future water quality in the estuary, due to as yet unquantified factors such as upstream effects, treatment plant reliability, non-point sources of pollution and permit enforcement.

Subject to this qualification, however, implementation of advanced wastewater treatment systems in the Merrimack River Basin has the potential to restore the practically defunct soft shell clam industry in the estuary to a valuable economic resource, by allowing the clam flats to be reopened to legal harvest and reintroducing the incentive for efficient management of the beds, whereby the present clam population could potentially be doubled.

There is as yet insufficient basis for making even qualified estimates of the potential impacts of the alternatives on finfish industries, such as the striped bass.

Ranking of the Alternatives

Rank	Alternative	Rationale
1	2	Deep-ocean outfall provided
2	3 & 4	Estuary outfall with prior AWT
3	5 & 6	Estuary outfall for Newburyport with SWT
4	1	Estuary outfall for both Newburyport & Salisbury; treatment level is SWT

4. Land Use

Long-term changes in land use are likely to occur in connection with interceptor placement, provision of sewer service, and modification of land for treatment facilities.

- Interceptors

The proposed alternatives differ primarily in the extent to which the proposed layout of interceptors avoids areas shown on existing plans as undesirable or unsuitable for high-intensity development. The differences across the alternatives and in degree of impact are relatively greater in the MVPC region than in the NMAC region.

Ranking of the Alternatives

In the MVPC region the avoidance of negative impact is best accomplished by the more decentralized, water-oriented alternatives, 1 and 2; whereas the more centralized, water-oriented alternatives, 3 and 4, least avoid planned open-space areas; the land-oriented alternatives fall in the middle.

- Collection Systems and Land Modification

Although provision of service to previously unsewered areas will have a major impact on the pattern and intensity of future development, the impact will not vary across the alternatives since the sewer service areas proposed are identical for all alternatives. The present assessment does, however, examine the congruence between proposed service areas and development objectives expressed in the regional plans for the study area. Instances of potential conflict between proposed service areas and/or facilities locations on the one hand, and regional plans are summarized below by community.

Merrimack Valley Regional Planning District

Amesbury

Collection System:

There are areas planned for low density public and private open space that will be served by the system. This could create pressure for development at higher densities. The impacts of the Alternatives 1-6 are identical to those of the EPA State Implementation Plan.

Land Modification:

The EPA State Implementation Plan and alternatives 1-4 call for a treatment plant to be located in an area planned for low density. These uses are not incompatible. In addition, Alternatives 5 and 6 will use 80 acres of a low density area for rapid infiltration.

Andover

Collection System:

The present sewered area will be expanded to include a planned low density area. This may create pressure for more intensive development. However an important planned industrial area will be served, thus facilitating development there. The impacts of Alternatives 1-6 are identical to those of the EPA State Implementation Plan.

Land Modification:

There are no treatment facilities proposed.

Boxford

Collection System:

No service area has been specified since for the foreseeable future septic tanks seem to be the most appropriate and desired means of wastewater disposal.

Land Modification:

Alternative 1 proposes a treatment plant in a planned low density area in South Boxford and there should be no major conflict. The EPA State Implementation Plan, and Alternatives 2, 3, 4, and 6 do not propose any facilities. The significant impact is the 180 acres to be used for land application by 1990 and the 400 acres to be used by 2020. Where land designated public and district open space is used there might be some change in the types of activities that can be carried out.

Georgetown

Collection System:

No service area is proposed for 1990. By 2020 the proposed service area will cover a medium density area, which is compatible with the land use plan. The impacts of Alternatives 1-6 are identical. They differ from those of the EPA State Implementation Plan in that they propose a service area in central Georgetown by 2020.

Land Modification:

The EPA State Implementation Plan does not propose any treatment facilities. Alternatives 1-6 call for treatment plants in planned open space areas. This will affect the types of activities that can be carried out there. Alternatives 5 and 6 propose 160 acres for land application by 1990 and 620 acres by 2020. This will impact planned low density and open space areas; affecting types of activities.

Groveland

Collection System:

No service area is planned by 1990; but service is proposed for a planned low density section by 2020. Therefore the long-term effects could be more pressure for intensive development. There is no difference between the EPA State Implementation Plan and Alternatives 1-6.

Land Modification:

The EPA State Implementation Plan and Alternatives 1-4 do not propose treatment facilities. Alternatives 5 and 6 call for 180 acres for land application by 1990 only. This will use land designated low density and will affect type of activities proposed for the area.

Haverhill

Collection System:

Planned high and medium density and industrial development areas will be added to the existing sewer service area by 1990. Some planned low density and open space areas will be included and these may experience pressure for more intensive development. The impacts of Alternatives 1-6 do not differ from those of the EPA State Implementation Plan.

Land Modification:

The EPA State Implementation Plan and Alternatives 1,2,5,6 propose a treatment plant in a planned medium density area by 1990. This could create a conflict. Alternatives 3 and 4 propose no facilities, thereby avoiding that conflict. Alternatives 5 and 6 would also use 350 acres of land planned for medium density for land application. This clearly conflicts with the regional land use plan.

Lawrence

Collection System:

No change in the service area is proposed.

Land Modification:

No facilities are proposed.

Merrimac

Collection System:

Service will be provided to planned medium density and industrial areas by 1990. Some planned low density areas will be included in the service area by 2020 and these may experience pressure for more intensive development. The impacts of Alternatives 1-6 and the EPA State Implementation Plan are identical.

Land Modification:

The EPA State Implementation Plan and Alternatives 1,5 and 6 propose treatment plants in planned low density area and Alternatives 2,3,4 propose no facilities. There should be no conflict. The major impact in the use of 280 acres of land by 1990 and 100 acres by 2020 for land application as proposed by Alternatives 5 and 6. However, since this is planned open space there should be no conflict.

Methuen

Collection System:

Some planned low density areas will be added to existing service area by 1990. There could be pressure for more intensive development here. The EPA State Implementation Plan and Alternatives 1-6 do not differ.

Land Modification:

There are no facilities proposed.

Newbury

Collection System:

By 1990 planned industrial, commercial, medium and low density areas will be served by all proposals. No further expansion is planned by 2020.

Land Modification:

No facilities are proposed.

Newburyport

Collection System:

The 1990 service area includes public and district open space and may create pressure for more development. Service to an industrial area supports the MVPC plan. The EPA State Implementation Plan and Alternatives 1-6 do not differ.

Land Modification:

The EPA State Implementation Plan and Alternatives 1,5,6 propose a treatment plant in a medium density area. There is local concern over use of waterfront property for this activitiy. Alternatives 2,3,4 propose a plant in a low density area and no conflict is anticipated.

North Andover

Collection System:

The service area will include planned open space low density areas. There may be some pressure for development here. A planned industrial area will also be served. The EPA State Implementation Plan and Alternatives 1-6 do not differ.

Land Modification:

The treatment plant proposed by all plans is near the Lawrence airport and should not create a conflict.

Rowley

Collection System:

No service area is proposed.

Land Modification:

The EPA State Implementation Plan and Alternatives 2,3,4 do not propose treatment facilities. Alternatives 1,5 and 6 call for treatment plants in areas of planned public open space. Alternatives 5,6, propose land application in 320 acres of planned open space. This could affect the type of activities in these areas.

Salisbury

Collection System:

Proposed service areas include some planned low density areas and might create pressure for more intensive development. Planned commercial and industrial areas will be served. The EPA State Implementation Plan and Alternatives 1-6 do not differ.

Land Modification:

All planned facilities will use land planned for public open space. This will affect the type of activities there. The EPA State Implementation Plan and Alternatives 1-6 propose a treatment plant. Alternatives 5 and 6 also include 110 acres for land application in planned open space.

West Newbury

Collection System:

No service area proposed.

Land Modification:

The EPA State Implementation Plan and Alternatives 1-4 do not propose facilities. Alternative 5 includes a treatment plant in a low density area and 260 acres of land application in planned low density area (no conflict). Alternative 6 does not include a treatment plant and proposes 570 acres in planned low density area (no conflict).

Northern Middlesex Area Commission

Billerica

Collection System:

The propopsed service areas will serve planned mixed use corridors, industrial park and planned high density commercial and residential centers. The impacts of the EPA State Implementation Plan and Alternatives 1-5 do not differ.

Land Modification:

No new facilities proposed.

Chelmsford

Collection System:

Although generally compatible with the NMAC regional land use plan the proposals would not serve an area in the southern part of the town that is currently developing and will need service eventually. The impacts of the EPA State Implementation Plan and Alternatives 1-5 do not differ.

Land Modification:

The EPA State Implementation Plan and Alternatives 2,3,4 do not propose any facilities. Alternative 1 includes a treatment plant in a planned open space-recreation area and one in a proposed industrial area (no conflicts). Alternative 5 includes a treatment plant in planned open space and 180 acres for land application in an area planned for low density suburban areas where development is to be discouraged.

Dracut

Collection System:

The phasing of service is not consistent with regional development plans. An industrial area and high density mixed use corridor and development areas planned for 1990 in the NMAC program would not be served until 2020. The impacts of the EPA State Implementation Plan and Alternatives 1-5 do not differ.

Land Modification:

No facilities are proposed.

Dunstable

Collection System:

No service area is proposed.

Land Modification:

The EPA State Implementation Plan and Alternatives 1-4 do not propose any treatment facilities. Alternative 5 would include acreage for land application that was planned for open space, recreation, suburban and town centers. Clearly the types of activities in these areas would be affected.

Lowell

Collection System:

The present service area will be expanded to include sections planned for low density suburban use. Increased pressure for more intensive development may result. The impacts of the EPA State Implementation Plan and Alternatives 1-5 do not differ.

Land Modification:

All plans include a treatment plant in a planned suburban area which should not present a major conflict.

Pepperell

Collection System:

Recent re-zoning provides for lower density in north central, western and southern sections. The proposed 2020 service area includes these and might create pressure for more intensive development there. A planned industrial site would not be served. The impacts of the EPA State Implementation Plan and Alternatives 1-5 do not differ.

Land Modification:

The EPA State Implementation Plan and Alternatives 1,2 propose a treatment plant in what is now a gravel pit zoned for industry. This presents no particular conflict of uses. Alternatives 3,4, do not include any facilities here. Alternative 5 would use 180 acres planned for industrial, low density suburban and open space for land application.

Tewksbury

Collection System:

The proposed service areas do not cover the entire town, and this, according to NMAC officials, is not compatible with the land use plan for Tewksbury.* Two small proposed industrial park sites are excluded from areas served, and there is a delay in service until 2020 in one area proposed as a 1990 development center. The impacts of the EPA State Implementation Plan and Alternatives 1-5 do not differ.

Land Modification:

No facilities are proposed.

Tyngsborough

Collection System:

Service areas include proposed open space suburban and corridor areas. There may be pressure to develop low density areas more intensively. The impacts of the EPA State Implementation Plan and Alternatives 1-5 do not differ.

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*Letter from Joseph P. Hannon, Director to NMAC Commissioners and Alternates, January 7, 1974, p.5.

Land Modification:

The EPA State Implementation Plan and Alternatives 1-4 do not propose any facilities. Alternative 5 includes 210 acres of land planned for an industrial park and this might be a major conflict.

Westford

Collection System:

The proposed service area is smaller than the NMAC plan service area and therefore does not serve planned industrial, commercial and residential development areas.* The impacts of the EPA State Implementation Plan and Alternatives 1-5 do not differ.

Land Modification:

The EPA State Implementation Plan and Alternatives 1-4 do not propose facilities. Alternative 5 includes use of a total of 770 acres of land for land application. Approximately 370 acres of this land is planned for some form of development (not open space) by 1990 and 110 acres planned for development by 2020. This is a major conflict.

Lancaster, Bolton, Fort Devens

Land Modification:

Four hundred and sixty acres of land are proposed for use for land application under Alternative 5. Most of the land is either planned open space or owned by the government. The land in Bolton is planned industrial use; thus there is a conflict in development goals.

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* Letter from Joseph P. Hannon, NMAC Director, to NMAC Commissioners and Alternates, January 7, 1974, p. 4.

5. Housing

Collection systems will affect locations where single-family housing can be built if soils are not suitable for on-site disposal. However, there are no differential impacts since collection systems are the same across all of the proposed alternatives.

Interceptor corridors will encourage high-intensity uses such as high-density housing. It is likely that land values will rise near interceptor corridors, which may favor displacement of low-income housing in these areas by uses with higher economic value. Here again, however, differences among the alternatives, in terms of their congruence with existing moderate and high-density residential areas, are too minor to justify a preference ordering as to their impact on housing.

6. Manufacturing and Employment

- Industrial Jobs

Significant impacts on manufacturing and employment in the study area will occur in connection with the costs incurred by industries for participation in public treatment systems. These costs will be of several types:

- Construction and O&M costs of pretreatment facilities
- Proportionate share of Federally financed capital costs
- Proportionate share of local debt service and annual O&M costs

Ranking of Alternatives

Given the small cost differences across the proposed alternatives, it is not useful to distinguish among them in terms of industrial job losses. However, if a rank ordering is desired, one based on total costs is most reasonable.

- Construction and O&M Jobs

There will be short-term employment benefits associated with the construction of treatment facilities, and minor long-term employment opportunities created by the operations and maintenance staffing requirements for the facilities.

Ranking of the Alternatives

The preference ranking based on number of construction jobs created is:

Rank	MVPC Alt.	NMAC Alt.
1	3 & 4	3
2	5 & 6	4
3	1 & 2	5
4		2
5		1

The number of full-time equivalent O&M jobs created in the MVPC region will be in the general range of 300 to 400, and in the NMAC region 100 to 300 jobs. Based on the number of jobs created, the preference ranking of the alternatives is:

Rank	MVPC Alt.	NMAC Alt.
1	4	1, 2, 3
2	3	5
3	1 & 2	4
4	5 & 6	

C. OTHER FINDINGS

Agriculture

The only aspect of the proposed alternatives expected to have a significant impact on agriculture in the study area is the proposal for spray irrigation associated with the land-oriented alternatives, 5 and 6. Spray irrigation would benefit agricultural operations in terms of both providing useful nutrients to the soil (thereby reducing farmers' expenditures on commercial fertilizers) and increasing the productivity of the land.

The degree to which these potential benefits are realized will depend, of course, on whether the spray irrigation sites are actually used for agriculture and, if so, whether crops cultivated on the sites are those that can make most profitable use of the nutrient "subsidy" provided, e.g., meadow grass or silage corn.

1. Ranking of the Alternatives

On the basis of potential benefits from spray irrigation, the land-oriented alternatives are clearly preferable to the water-oriented alternatives. In the MVPC region Alternative 5 is slightly more desirable than Alternative 6 in that 95 more acres are proposed for spray irrigation under Alternative 5.

2. Transportation

The only significant impacts of proposed alternatives on transportation in the study area will be the short-term effects of pipeline construction, whereby traffic congestion will increase during peak travel times on roads affected. There will be virtually no disruption of traffic flows on interstate or state highways since tunneling under these highways is required.

Ranking of the Alternatives

In the MVPC region, Alternatives 1 and 2 involve slightly less impact on local streets than do Alternatives 3-6. In the NMAC region, Alternatives 1 and 2 likewise avoid impacts somewhat better than the others, and alternative 5 least well avoids impacts on local streets.

3. Service Sector

Minor impacts on the service sector are expected to result from implementation of any of the proposed alternatives: benefits should accrue to this sector in connection with increased recreation activity, future growth and development in sewered areas, and sales of treatment plant supplies; on the other hand, some negative impact could occur among industrial support firms if there are any significant industrial losses associated with requirements for industrial pollution abatement. Such effects as those enumerated above, however, are indirect, third-order consequences of implementing various plan actions that are essentially common to all of the proposed alternatives; therefore, differences among the alternatives at this level of assessment are not great enough to warrant distinguishing the relative magnitude of their impacts on the service sector.

4. Population

Net population and population distribution in the study area are not expected to be affected significantly by any of the proposed engineering alternatives, for the following reasons:

(1) Collection systems have been designed to support the size and pattern of the future population that is expected to obtain in the study area.

(2) Interceptor corridors, too, have been designed to follow, as nearly as practicable, the lines of existing and planned development. In a few instances, particularly in the more centralized alternatives (3 and 4), interceptors would cross open areas that are shown on regional plans to be undesirable or unsuitable for development. Interceptors could in these areas stimulate unplanned-for, high-intensity development unless

tie-in regulations are strictly enforced.

(3) Although probable job losses associated with industrial abatement requirements may have short-term effects on labor force movement, it is assumed that in the long-run, abatement requirements will be instituted nationwide, thus equalizing any differential employment impacts.

(4) A dramatic improvement in water quality would increase the attractiveness of the study area as a place to live and work and thus contribute to in-migration to the area. The magnitude of the effect will depend in large part on the extent of increase in recreation and service sector employment opportunities.

The effects on population movement of (3) and (4) above are tertiary effects of implementing proposed engineering alternatives and the present analysis of industrial impacts and water quality regions does not warrant differentiation among the AWT alternatives in times of the magnitude of impacts on population.

IV. RECOMMENDATIONS FOR FURTHER STUDY

Substantially more research than was possible under the scope of the present study would be necessary to confirm and make more precise the estimates of impacts presented in this report. Those impact categories, in particular, where further research is desirable are: municipal finances, manufacturing, land use, recreation and housing. The types of research efforts needed are outlined below.

Municipal Finances

- Possible options should be investigated for providing assistance to towns in the funding of municipal collection systems.

- To assess fully the impact of operations costs on individual town budgets, each town's share of operations costs should be determined as a percentage of its municipal budget excluding intergovernmental transfer payments.

Manufacturing

- A detailed survey of manufacturing firms in the study area is needed to obtain better information on the costs of compliance with abatement requirements and expected employment impacts. The survey should be combined with further analysis of engineering costs of pre-treatment.

Land Use

- More detailed study of individual town's land use goals should be undertaken before plans for municipal collection systems are finalized. The strong influence that collection systems would have on future development patterns warrants a clearer definition of communities' development goals.

Recreation

- More detailed analysis of land use goals would also identify specific sites where recreation benefits will be greatest. In addition, recreation impact estimates presented here should be refined as results of new recreation demand studies become available.

Housing

- An up-to-date inventory of existing and planned housing on the sites proposed for land disposal is needed to provide a more precise count of the households that would be displaced. Demographic data on these households should also be collected to determine whether the displacements will affect low-income or minority persons who might have particular difficulty in obtaining suitable replacement housing.

V. IMPACT CATEGORIES

Agriculture

Commercial Fisheries

Service Sector

Land Use

Housing

Transportation

Recreation

Manufacturing and Employment

Personal Income and Wealth

Municipal Finances

Municipal Services

Population

A. IMPACT CATEGORY: AGRICULTURE

Introduction

The agricultural sector no longer constitutes a significant portion of the total economy in this relatively industrialized region. While it is still locally an important economic factor outside the urbanized areas, farming has been, and continues to be, on the decline. This trend is readily apparent from statistical data (1) on the state's agricultural employment, income and production. In 1971, less than 1% of the labor force was employed as farm workers; average annual income per worker was only $5291; and decreasing acreage is devoted to this sector. The percentage of farm land in Essex and Middlesex Counties decreased by 30% and nearly 50% respectively, during the period 1959-1969. However, the value of all farm products sold remained constant between 1964 and 1969, while production per farm increased. Those towns in the study area where significant portions of land are still used for agriculture are West Newbury, Merrimac, Rowley and Boxford in the Merrimack Valley Planning Commission, and Dracut, Pepperell, Dunstable and Westford in the Northern Middlesex Area Commission.

Although the trend in New England farming practices is toward larger-size operations and fewer farmers, farms still remain small relative to those in other parts of the nation. In terms of total cash receipts from farm marketing, crops and livestock contribute approximately equal shares (1). Crop production is concentrated chiefly on nursery products and hay, and livestock on dairying and eggs, followed by cattle and hogs(2). Given the relatively limited scale of agricultural operations in the Merrimack Basin, impacts on this sector would not be expected to have significant multiplier effects on the total economy of the region. By the same token, however, smaller farms are less able to absorb any economic losses that may result from either funding or pollution abatement requirements of wastewater management systems, or to take advantage of possible opportunities for the use of sewage sludges.

Interest groups that stand to be affected by impacts on the agricultural sector are not limited to farmers; as a concomitant of rapid urbanization in this region, many residents have recently expressed a heightened concern for preserving agricultural lands, pasture and working farms; and agriculture has assumed a special value as a means of protecting open space.

Plan Actions and Indicators of Impact

The plan actions of proposed engineering alternatives that will be of interest to farmers are the following:

- Treatment Products--Use of Treated Wastewater for Crop Irrigation
- Treatment Products--Use of Sludges as Fertilizer
- Capital Cost and Operations Funding
- Private Abatement Actions--Agricultural Runoff Controls

1. Treatment Products: Use of Treated Wastewater for Crop Irrigation

Of the plan actions associated with the various wastewater management alternatives, spray irrigation of secondary-treated effluent, as proposed for several sites under the "Land-Oriented" alternatives (Alternatives 5 and 6 in the MVPC region; Alternative 5 in the NMAC region) would have the most appreciable impact on agriculture. Funding requirements, insofar as they would affect farmers, do not differ substantially across the alternatives and other impacts of potential significance (sludge disposal and runoff controls) are not as yet incorporated into any of the proposed alternatives. The spray irrigation components of land-oriented alternatives, however, can be expected to have definite, quantifiable benefits to local agriculture, in the way of increasing the commercial production of forage crops and hence raising gross farm income. A more indirect and unquantifiable benefit associated with the spray irrigation proposals is long-term, if not permanent, preservation for agricultural use of sites that might otherwise be subject to development pressures.

The criteria used for selecting sites suitable for spray irrigation--well-drained soils, good depth to bedrock, adequate loam, soil not too strong--are also those which identify land well-suited to crop production. The spray irrigation sites chosen in the MVPC region contain a total of 1800 (Alternative 6) to 1895 (Alternative 5) acres, and sites in the NMAC region, including a portion of Carlisle, contain a total of 800 acres of land where crops such as meadow grass and silage corn can profitably be grown. Production of food for direct human consumption, such as light truck farming, would probably not be permitted by the State because of possible negative public health impacts.

The distribution of proposed spray irrigation sites among the various towns involved is as follows:

Spray Irrigation

Total Acreage Proposed by Community

MVPC	Alternative 5	Alternative 6
Boxford	465	450
Georgetown	460	460
Merrimac	380	0
Rowley	320	320
West Newbury	270	570
	1895 acres	1800 acres

NMAC	Alternative 5
Chelmsford-Carlisle	180
Westford	620
	800 acres

Spray irrigation would provide the sites involved the equivalent in soil nutrients of 250 lbs/acre application of commercial nitrogen fertilizer.(3) At current fertilizer prices this would represent a $70/acre nitrogen "subsidy" to the farmers affected, or $132,650 under Alternative 5 and $126,000 under Alternative 6 in the MVPC region, and $56,000 under Alternative 5 in the NMAC region.

Application of this quantity of nitrogen leads to a direct increase in the productivity of the land.(4) Farmers could expect a fairly consistent increase of one ton of meadow grass per acre over what the land would yield unsprayed. The current market price of meadow grass in Massachusetts is approximately $70/ton, so that the initial nitrogen subsidy could lead to additions to gross farm income in the same amounts listed above: $132,650 under Alternative 5 and $126,000 under Alternative 6 in the MVPC region, and $56,000 under Alternative 5 in the NMAC region.

Alternatively, the same nitrogen application increases the potential yield from silage corn by roughly three tons per acre. At the current market price of silage corn, $20/ton, the increase in gross farm income would amount to $113,700 under Alternative 5 and $108,000 under Alternative 6 in the MVPC region, and $48,000 under Alternative 5 in the NMAC region.

Overall, then, the alternatives involving spray irrigation of treated effluent could lead to increases in gross farm income in roughly the following ranges:

MVPC Region

Alternative 5: from $246,350 to $265,300

Alternative 6: from $234,000 to $252,000

NMAC Region

Alternative 6: from $104,000 to $112,000

2. Treatment Products: Use of Sludges as Fertilizers

Although at present incineration and land fill is the proposed method for disposal of sludges produced in sewage treatment plants, the use of sludges as a replacement for commercial fertilizers such as nitrogen and phosphorus is a potential application of interest to farmers, provided it can be proved cost-effective. Sludges have not previously been used for this purpose in the New England area, and the experience elsewhere does not yet show great promise. The Metropolitan Sanitary District of Greater Chicago (5), which has been experimenting with land application of digested sludges since the mid-1960s, has not been successful in generating income from the sale of liquid sludges because farmers have not been convinced of its economic desirability. Attitudes may change in the future, particularly if the price of commercial fertilizer continues to rise; however, the prospects for farm use of sludges in this region are not at present encouraging since most farms are small-scale operations, and the distance of large farms from treatment plant sites would involve high transportation costs.

3. Capital Cost and Operations Funding

Rising property taxes have in recent decades been a major factor in the conversion of agricultural lands to higher-return residential, commercial and industrial uses. Serious concern is expressed by farmers in the study area that the funding requirements for the construction and operation of proposed sewage treatment systems will bring further increase in tax rates that will serve to accelerate the decline of agriculture in the region. Although tax rates in the Basin are expected to increase for property owners, owners of agricultural land are now afforded property tax relief by the 1973 Farm Land Assessment Bill (Chapter 1118), which provides for tax assessment based on agricultural use rather than the highest use of land. Thus, while tax rates for farmers would increase, the increase will take place at a lower assessment level.

Obviously, the survival of a given farm depends on several factors other than property taxes--for instance, the price an owner could receive from the sale of his land to a developer. Moreover, it is impossible to estimate with any accuracy the number of marginally profitable farms now operating that would be likely to go out of business at some critical tax level in the future. It might be assumed, however, that farms that have managed to survive tax payments prior to the abatements provided by Chapter 1118 are therefore likely to survive tax rate increase in the future on a lower valuation.

It can be expected that the impact of tax rates will be generally proportional to the costs of the different alternatives in a given town. Thus, the EPA State Plan, which proposes only secondary treatment in all municipalities, would affect farmers (as well as all other taxpayers) least; and of the advanced treatment alternatives, the land-oriented proposals are more costly than the water-oriented proposals.

4. Private Abatement Actions: Agricultural Runoff Controls

Although no quantitative estimate of surface water contamination from agricultural runoff in the study area is yet available, runoff controls may eventually be instituted that would limit the use of fertilizers and pesticides and regulate confined dairy production. The extent to which decreased use of fertilizers would reduce crop yield depends on current use levels. Limitation of the types and quantities of chemicals used in pest control would result in crop losses and/or higher prices to be paid for substitute chemicals, and would thereby reduce farm profits. Pesticide use is particularly important in orchard and truck farming operations. Feedlot runoff controls would inevitably increase farming costs and thus contribute to the decline in the number of farms.

DATA SOURCES

(1) 1972 Massachusetts Agricultural Statistics.

(2) 1969 Census of Agriculture, part 4: Massachusetts, U.S. Department of Commerce.

(3) Conversation with Mr. Robert Satterwhite, soil scientist with the New England Division, U.S. Army Corps of Engineers.

(4) Conversation with Dr. Martin Weeks, State Extension Agent, University of Massachusetts, Amherst.

(5) Barbolini, Robert R., Institutional Options for Recycling Urban Sludges and Effluents on Land, Metropolitan Sanitary District of Greater Chicago.

B. IMPACT CATEGORY: COMMERCIAL FISHERIES

Introduction

Commercial fishing in the Merrimack River Basin has historically been, and is expected to continue to be, limited largely to the estuary. Although sport fishing flourishes today in the estuary, commercial fishing has declined radically from the strong position it once enjoyed in the area's economy. The most economically valuable fish species in the estuary is the soft shell clam, but pollution of estuary waters has kept local clam flats closed to legal harvest since 1945. It appears that implementation of wastewater management systems throughout the study area, together with careful management of clam beds, could restore the local clam industry and ultimately bring economic benefits on the order of $750,000 annually.

Little can be concluded regarding potential changes in the sales of finfish such as the striped bass and sand eel, which are today viable industries in the estuary. The documentation does not exist for making useful projections of the impact of water quality changes on these species. Even the estimates of potential economic benefits to the clam industry are subject to strong qualification because of present uncertainty with respect to some major factors in future water quality in the estuary: upstream effects, treatment plant reliability, non-point sources of pollution enforcement of discharge permits. Since it was not possible to quantify the potential effects of any of these factors so as to introduce them into the calculation of benefits, it is important to issue a caveat as to their potential effect on the benefits enumerated below.

Finfish: background

Beginning in the colonial period, the Merrimack River estuary fishery resources, including sturgeon, shad, salmon and alewives, were commercially exploited. As early as the 1800s, however, commercial fishing started to decline due to a combination of industrial pollution and over-harvest. Also, dams built across the river prevented anadromous fish species from reaching their spawning grounds. In the 1900s, recreational fishing in the estuary began to grow in importance and has continued to do so, far outpacing commercial fishing activities in the estuary. Today, the only important fish commercially harvested are the striped bass (also a highly valued sport fish) and the sand eel.

Finfish: impacts of proposed wastewater management alternatives

The effects on fish species in the estuary of instituting secondary wastewater treatment systems in the study area (as proposed by the State Implementation Plan) cannot be precisely measured. Advanced treatment, as proposed by the Corps of Engineers' alternative plans for the Basin, may possibly benefit estuarine fish communities somewhat; but here again, there is no documented basis for quantifying changes in the population and diversity of fish species that might occur. Until the necessary data are available, potential dollar benefits cannot be calculated. For a detailed discussion of water quality parameters affecting aquatic life in the estuary and the findings to date, the reader is referred to the separate report and aquatic impacts Appendix IV-B - Volume 1.

Shellfish: background

Shellfish were also an important commercial resource in the estuary area for many years. Shellfishing, principally the soft shell clam food and bait industry, gained major importance only in the mid-18th Century and apparently reached its height in the latter half of the 19th Century, although the industry has fluctuated widely throughout its existence. Digging of clams for human consumption was disallowed in the estuary flats in 1925 because of pollution. The industry was revived for a period by the opening of the Shellfish Purification Plan on Plum Island in 1928. However, increased pollution continued to reduce the area open to clam digging, and since 1945 the Merrimack River estuary clam industry has been virtually non-existent.

Shellfish: impact of proposed wastewater management alternatives

Soft shell clams are the only commercially significant shellfish species in the Merrimack River estuary. There are approximately 770 acres of clam beds in the estuary, 57% of which are located in Newburyport, 28% in Salisbury, and 15% in Newbury. A 1965 report prepared by the Division of Marine Fisheries (1) estimated that these beds produced 73,379 bushels of legal-sized clams, with an approximate wholesale value (unrealized) of $300,000.

The following assumptions were made in estimating the change in the economic value of the soft shell clam industry that could result from the improved water quality achieved by advanced wastewater treatment systems:

1. Clam population

In the long run, here represented by the year 2020, it is assumed that the clam population will be double its 1963-64 size (1), provided that proper management is practiced to prevent over-harvesting, and assuming no discharge of untreated wastewater into the estuary. Based on the assumption that the clam population will double by 2020, the 1990 short term population is estimated to be 20% higher than it was in 1963-64. The increase is expected to be slight since insufficient time will have elapsed to restore the population to its full potential. It is further assumed that the long and short term clam populations will be the same with secondary treatment as with advanced treatment systems in the estuary area since there are no quantitative data available to document any differential effects of various levels of water quality on clam population.

2. Harvest rate

The maximum annual harvest that would not deplete future generation of clams is 40% of the total population.(1)

3. Quality and Disposition of Effluent

Among the six wastewater management alternatives proposed for this area, effluent from treatment plants would be discharged either directly to the estuary (Alternatives 1, 3, 4, 5 & 6), to the ocean (Alternative 2), or, in the case of Salisbury, to land sites (Alternatives 5 & 6). Although further research is needed in order to quantify the effects, biologists studying the area believe that discharge of treated effluent to the estuary will result in close contact between effluent and shellfish (the danger being greater when the effluent has received only secondary treatment) and will also pose a greater health hazard in the event of treatment plant malfunction. It is assumed here that under all alternatives involving discharge to the estuary of effluent that has received only secondary treatment (the State Implementation Plan and Alternatives 1, 5 & 6) clams would require purification prior to sale, thus reducing the net economic benefit to wholesalers.

Estimates of potential economic benefits to the Merrimack estuary clam industry, based on the assumptions listed above, are contained in the chart on the following page. The ranking of the six engineering alternatives that is presented below is based on water quality considerations affecting the safe harvesting of fish for human consumption.

Rank	Alternative	Rationale
1	2	Deep-ocean outfall provided
2	3&4	Estuary outfall with prior AWT
3	5&6	Estuary outfall for Newburyport with SWT
4	1	Estuary outfall for both Newburyport & Salisbury; treatment level is SWT

TABLE 3: ANNUAL ECONOMIC BENEFIT TO THE SOFT SHELL CLAM INDUSTRY

Benefits in 1974 Dollars		Wholesale Price 1974	Gross Est. Pop. of Legal-Sized Clams 1963-64*	Gross Potential Annual Allowable Harvest (40% of Total Population)			
				State Implementation Plan Alternatives 1, 5, 6		Alternatives 2, 3, 4	
				1990	2020	1990	2020
Gross Annual Benefit	Bushels	$13.50/bushel	73,379 bushels	35,222	58,703	35,222	58,703
	Dollars			$475,497	$792,490	$475,497	$792,490
Purification Costs		$ 1.00/bushel		35,222	$ 58,703	$ 0	$ 0
Net Annual Benefit				$440,275	$733,787	$475,497	$792,490

TABLE 4: EXPECTED IMPACT ON COMMERCIAL FISHERIES

Geographic Area: Merrimack River Estuary

Impact: Water Quality/Commercial Fisheries

Summary of the Change in the Wholesale Value of Commercial Fisheries

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan) Secondary Waste Treatment	Wholesale value of commercial fisheries	$440,275		$733,787	
Alternatives 1, 5, 6 Secondary Waste Treatment	Same as above	$440,275	No Change	$733,787	No Change
Alternatives 2, 3, 4 Advanced Waste Treatment	Same as above	$475,497	$35,222	$792,490	$58,703

DATA SOURCES

(1) Division of Marine Fisheries, Massachusetts State Department of Natural Resources, A Study of the Marine Resources of the Merrimack River Estuary, 1965.

(2) Telephone contacts with the following agencies:

- Department of Natural Resources
- Massachusetts Division of Water Pollution Control
- Salisbury Municipal Sewer Commission
- United States Public Health Service

C. IMPACT CATEGORY: SERVICE SECTOR

According to baseline projections* for the study area, the economy of the Merrimack River Basin is expected to experience a structural shift from an economy based primarily on manufacturing toward an economy based on services. It is anticipated that by the year 2020, non-manufacturing jobs will far out-number manufacturing jobs. Impacts on the manufacturing and service sectors resulting from implementation of advanced wastewater treatment systems in the study area are generally expected to reinforce this "without project" trend: short term employment losses in the manufacturing sector stemming from industrial abatement requirements may accelerate the shift away from manufacturing in the basin; while service sector employment will be enhanced by increases in recreation and tourism and sales of supplies for treatment plant operations.

Specific plan actions of proposed AWT alternatives that will exert impacts on the service sector are: Water Quality Objectives; Construction; Private Abatement Actions; and Operations.

Water Quality

The improvement of water quality in the Merrimack River and associated waterways is expected to result in a substantially increased demand for water-based and water-related recreation activities. Increased participation in recreation activities, on the part of both residents of the study area and tourists coming into the basin, will result in increased demand for services related to these activities, such as restaurants, fast-food establishments, fishing equipment sales and rentals, marinas, and the like. The recreation-related service sector is consequently expected to benefit significantly from these changes, in the form of increased volume of business, profits and employment. Since these benefits to the service sector will increase in proportion to the increase in recreation activities available, the impact may be substantially greater under the advanced wastewater alternatives designed to achieve fishable and swimmable water quality, than under the EPA State Program which proposes only secondary wastewater treatment throughout the study area.

Construction

Short-term benefits from construction activities will accrue to the local service sector through (1) local expenditures made by construction workers hired from outside the area and (2) local purchase of construction materials. The extent of these benefits will depend

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* See "Socio-Economic Profile of the Basin", Appendix I - Background Information.

in large degree on whether the construction contractor is a local firm. On the one hand, a contractor from outside the area would likely hire more workers from outside so that the local increase in worker expenditures would be proportionately greater. On the other hand, a contractor from outside the area would also be more likely to purchase materials from firms outside the area. It is considered probable, in the case of the present study, that the contractor will not be a local firm, and that the ratio of workers hired from the study area to those hired from other areas will be approximately 50/50. It is also expected that those workers hired from outside will reside within commuting distance, so that their expenditures in the study area would be limited to food, beverage and gasoline purchases in the course of the work day. It is not possible to estimate in advance whether the choice of a local or an outside construction firm would result in greater positive impact on local service sector sales.

Private Abatement Actions

The one action associated with implementation of wastewater treatment systems that is anticipated to have adverse effects on the service sector is the pollution abatement required of manufacturing firms. If abatement standards cause a substantial number of local firms either to cut back production or to cease operations altogether, the service sector firms supporting them will experience business volume and profit losses. The types of service sector firms likely to be affected include banks, insurance companies, distributors, utilities, and data processing companies. As noted in the chapter on Manufacturing, manufacturing losses may be expected to occur in rough proportion to the costs of the different alternatives; hence, losses would be significantly smaller under the EPA Program of secondary wastewater treatment than under the proposed alternatives for advanced wastewater treatment.

Operations

Long-term benefits are expected to accrue to the service sector through the sales of chemicals used in the operation of wastewater treatment facilities. Also, the power requirements of treatment operations will create additional demand for output from the local utilities industry. Although it is likely that chemicals would be manufactured outside the study area, it is anticipated that in the long run, they will be supplied to treatment facilities through local distributors. The volume of chemicals and power that will be needed will vary with the type of treatment facility: lesser amounts are required for secondary than for advanced wastewater treatment facilities; and among the AWT alternatives the land-oriented systems consume substantially smaller amounts of resources than do water-oriented systems, as reflected in the different operating cost estimates. (A detailed discussion of resource requirements is contained in Appendix III - Volume 1.

D. IMPACT CATEGORY: LAND USE

A major form of broad-scale impact that often results from implementation of wastewater treatment systems is change in land use. Plan actions that will induce long term changes in land use are Collection System--Interceptors; Collection System--Sewer Service Areas; and Land Modification for facilities construction.

Collection System--Interceptors

Differential Land Use Impacts of Alternative Plans According to Interceptor Locations

Locations of interceptor lines will generally affect the pattern of regional growth and development. Higher intensity uses such as business, industry and high density housing are more economical to sewer if they are located near a major interceptor; and local communities generally attempt to pattern their zoning ordinances to reflect the consequent higher land values near interceptor sewer lines.

The impacts of the alternative interceptor plans have therefore been evaluated differentially with respect to the following criteria:

(1) does the proposed layout go through existing or proposed (in plans) business and industrial areas;

(2) does the proposed layout go through existing or proposed (in plans) medium and high density residential areas;

(3) does the proposed layout avoid areas shown on existing plans as undesirable or unsuitable for higher intensity development?

The impacts of the alternative plans have been evaluated as follows:

+ positive impact; or relatively better, compared to other alternatives;

- negative impact; or relatively poorer, compared to other alternatives;

0 neutral impact, or at least no differential impact.

	Plan Alternative (Land)						
MVPC	Criteria	1	2	3	4	5	6
Salisbury	3	-	-	-	+	-	-
Rowley	3	-	+	-	-	0	0
Boxford	3	+	-	-	-	0	-
Georgetown	3	+	+	-	-	0	-
Groveland	3	0	0	0	0	0	0
Andover, N. Andover, Lawrence, Methuen	3	+	+	+	-	0	0
Newbury	3	0	0	-	-	0	0
Haverhill	3	0	0	-	-	0	0
Merrimac	3	0	0	0	0	-	0
Amesbury	3	-	+	-	-	0	0
Newburyport	3	-	-	0	0	0	0
West Newbury	3	+	-	0	0	-	-
NMAC							
Tewksbury	1,2,3	0	0	0	0	0	
Billerica	2	0	0	+	0	+	
Chelmsford	1,2,3	0	0	0	0	0	
Westford	3	0	0	0	0	-	
Pepperell	1,2,3	0	0	0	0	0	
Dunstable	1,2,3	0	0	0	0	0	
Tyngsborough	2	0	0	0	0	+	
Dracut	1,2,3	0	0	0	0	0	
Lowell	1,2,3	0	0	0	0	0	

Very few differences appear to exist in terms of criteria 1 and 2 above, i.e., in the degree to which existing or planned higher intensity uses would be accessible to interceptor corridors. However, differences do exist in terms of corridors passing near or through areas considered unsuitable for development (criterion 3).

In addition, there has been considerable sentiment in favor of non-structural solutions, especially with respect to relatively low density communities such as Boxford and Rowley. Although

non-structural solutions were not extensively evaluated, such non-structural solutions would clearly avoid the creation of development pressures in unsuitable areas that might result from any of the Alternatives now under consideration.

Data Sources:

(1) "Regional Land Use Plan," Central Merrimack Valley Regional Planning District (undated).

(2) Northern Middlesex Area Commission, Existing Zoning, 1973.

(3) NMAC Vacant Land Analysis.

(4) "The Merrimack: Designs for a Clean River," Appendix I, Background Information.

Collection System--Sewer Service Areas

The collection system will affect the location and density of development by providing one basic service needed to support growth. Once such services are provided to an area, additional growth will likely occur to take advantage of these services. Conversely, the system may constrain development by not providing services to areas where growth was to be encouraged.

Land Modification

Changes due to land modification result either from construction of treatment facilities or designation of land areas for land application sites. In the first case, a change in the land use specified for a particular site might be necessary because of incompatibility between the new use (e.g., treatment plant) and the planned use for the site (e.g., high density residential). Finally, land use changes can occur where large amounts of land are required for land application and may consequently be shifted from one land use category to another.

Methodology

Our procedure for assessing the impacts of wastewater treatment facilities on adjacent land uses was to identify those sites where land use conflicts are expected and to investigate the type of change in land use that is likely to occur. This was done by examining the location of the affected area (either collection system or land application site) in relation to the regional land use plan, and evaluating the compatibility of the wastewater treatment facility with the type of development planned for the area. Although the use of local land use plans might have been more precise, up-to-date plans were not available for every town and the number of communities involved made this approach unfeasible. After discussion with MVPC and NMAC planners it was assumed that, with noted exceptions, these plans are the expression of the development goals and objectives of the communities in the region.

Conflict may be identified in several ways. In the case of the collection system service area, conflicts may occur because areas that were planned for future development (medium to high density residential, commercial and industrial areas) will not be included in the service area, or because the collection system will create pressure for more development in low density or open space areas. Land application sites will create conflicts when the site uses land intended for more intensive development; however, these facilities are also not considered compatible with adjacent high density development.

Description of Regional Land Use Plans

Merrimack Valley Regional Planning Commission

The land use plan for the Merrimack Valley Planning Commission indicates the type and location of development presently planned for the area. Land use categories in the plan include:

(1) Public Open Space: areas controlled by government agency to:

- provide parks and other major recreation resources
- protect and conserve major natural features
- separate the region from adjacent regions

(2) Open Space District: areas of non-governmental ownership where the following uses would be encouraged:

- agricultural and forestry uses
- recreational uses, such as golf courses, country club, scout or "Y" camps, retreat centers, rod and gun clubs, stables and riding academies
- cemeteries and public and semi-public institutions which maintain large, landscaped grounds with few buildings
- private residences on lots containing one or more acres per housing unit

(3) Residential: open space district - 1/2 - 1 family/acre
low density - 1 - 2 1/2 families/acre
medium density - 2 1/2 - 5 families/acre
high density - 5 and more families/acre

(4) Commercial: central commercial areas and shopping centers

(5) Industrial: areas with great development potential for both manufacturing and wholesale uses

Basically, the land use plan calls for concentration of development in Lawrence, Haverhill, and Amesbury, with low density residential and open space predominating in other areas.

Northern Middlesex Area Commission

The land use plan for the Northern Middlesex Area indicates the type and location of future development planned for the area. It is based on a center-corridor pattern that has five major components: open space and recreation; development centers; corridors; major industrial parks; and suburban areas.

(1) Open Space and Recreation: designation of open space and recreation areas to:

- preserve those areas unsuitable for development
- provide a continuous open space network for active and passive recreation
- maintain some semblance of rural atmosphere
- provide relief for urbanization

(2) Development Centers (regional, town, neighborhood and commercial):

- concentration of commercial activities, high density residential use, services and governmental administration

(3) Corridors: major routes for the movement of people and goods along major arterials. Medium density service and commercial areas and residential development

(4) Industrial Parks: concentration of industries in parks at least 50 acres in size

(5) Suburban areas: density of up to one unit per five acres on the average, so as to discourage development and preserve open space.

According to NMAC staff, wastewater treatment facilities could be located only in very low density areas without creating a land use conflict (location of facilities in Development Corridors will probably have to be judged on a case-by-case basis.)

The following tables display land use changes from the baseline and among alternatives. Tables 5-34 refer to the fifteen communities in the Merrimack Valley Planning Commission region, and Tables 35-53 to the nine communities in the Northern Middlesex Area Commission region and Fort Devens.

Key to Chart Notation

1. T.P. - treatment plant
2. L.A. - land application
3. R.I. - rapid infiltration
4. S.I. - spray irrigation

TABLE 5

Geographic Area: Amesbury

Impact: Collection System/Land Use

The significant impacts occur where areas designated public and district open space will be served. This might create pressure for development that would conflict with the open space use.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	Service areas cover low density areas		Service areas cover District open space in SW and NE and Public open space in NW	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 6

Geographic Area: Amesbury

Impact: Land Modification/Land Use

The treatment plant and R.I. site will use land presently planned for low density development.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	T. P. in low density		No additional facilities	
Alternatives 1-4	Same as above	Same as above	No change	Same as above	No change
Alternatives 5,6	Same as above	T. P. in low density area 80 acres R. I.	T. P. in different location L. A. site in low density area	Same as above	No change

TABLE 7

Geographic Area: Andover

Impact: Collection System/Land Use

Most of central Andover is presently sewered. The enlarged service area may create pressure for more intensive development in areas now planned for low density. An important industrial area will be served.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	Includes low density area and industrial area in NW Corner		Adds low density area	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 8

Geographic Area: Andover

Impact: Land Modification/Land Use

There are no facilities proposed.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	No facilities proposed		No facilities proposed	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 9

Geographic Area: Boxford

Impact: Collection System/Land Use

For the foreseeable future, septic tanks seem to be the most appropriate and desired means of wastewater disposal.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatability of service area with regional land use plan	No service area specified		No service area specified	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 10

Geographic Area: Boxford

Impact: Land Modification/Land Use

The significant impact is the 180 acres to be used for land application by 1990 and the 400 acres to be used by 2020. Where land designated public and district open space is used, there might be some change in the types of activities that can be carried out.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	No T. P.		No additional facilities	
Alternative 1	Same as above	T. P. in South Boxford	T. P. in low density area	Same as above	No change
Alternatives 2-4,6	Same as above	No T. P.	No change	Same as above	No change
Alternative 5	Same as above	T. P. in South Boxford 105 acres S. I. 75 acres R. I.	1. In low density area 2. Public and district open space	100 acres S.I 140 acres S.I 40 acres R.I 120 acres S.I	Change from public and district open space

TABLE 11

Geographic Area: Georgetown

Impact: Collection System/Land Use

There is no short-term change from the baseline. By 2020 the proposed service area will cover a medium density area. This is compatible with the land use plan.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	No service area proposed		No service area proposed	
Alternatives 1-6	Same as above	Same as above	No change	Service area in central Georgetown	Service area planned for medium density

TABLE 12

Geographic Area: Georgetown

Impact: Land Modification/Land Use

The treatment plant for all Alternatives will be in a public open space area. The major impact is 160 acres for R.I. in a low density area by 1990, and 160 acres for S.I. in a low density area and 300 acres for S.I. in district open space area.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	No T.P. No L.A.		No additional facilities	
Alternatives 1-4	Same as above	T.P. on Pentucket Pond, T.P. in central Georgetown	Change from public open space, change from district open space	Same as above	No change
Alternatives 5,6	Same as above	T.P. on pond 40 acres R.I. 120 acres R.I.	Change from public open space. Change from low density area	80 acres S.I. 80 acres R.I. 300 acres S.I.	Change from low density area. Change from district open space

TABLE 13

Geographic Area: Groveland

Impact: Collection System/Land Use

The MVPC plan recommends low density development in Groveland. Lack of sewer service by 1990 should not interfere with this goal. There may be pressure for more intensive development in those areas served by 2020.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	No service area proposed, low density development is planned		Service to parts of Central & S.W. Groveland low density development	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 14

Geographic Area: Groveland

Impact: Land Modification/Land Use

The only impact is the 180 acres for R.I. by 1990 that will use land designated low density development.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	No T.P. No. L.A.		No additional facilities	
Alternatives 1-4	Same as above	Same as above	No change	Same as above	No change
Alternatives 5,6	Same as above	No T.P. 160 acres R.I. 20 acres R.I.	Change from low density	Same as above	No change

TABLE 15

Geographic Area: Haverhill

Impact: Collection System/Land Use

The existing high density areas will continue to be served. Medium density areas in E. Haverhill and low and medium density and industrial areas in W. Haverhill will be included. There may be pressure for more development in the low density areas and in a section of district open space in N. Haverhill.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	Serves planned development areas in Central, E. & W. Haverhill, includes area in N. Haverhill designated district open space		No additions to service area	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 16

Geographic Area: Haverhill

Impact: Land Modification/Land Use

The only significant impact is the use of 350 acres of land for R.I. by 1990. This will use land planned for medium density development.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	T.P. in area designated medium density		No additional facilities	
Alternatives 1,2	Same as above	Same as above	No change	Same as above	No change
Alternatives 3,4	Same as above	No T.P.	Land available for planned use	Same as above	No change
Alternatives 5,6	Same as above	T.P. in medium density areas 220 acres R.I. 130 acres R.I.	No change Change from medium density	Same as above	No change

TABLE 17

Geographic Area: Lawrence

Impact: Collection System/Land Use

All of Lawrence is presently served by the GLSD., and there will be no change in the service area.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	No addition		No addition	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 18

Geographic Area: Lawrence

Impact: Land Modification/Land Use

There are no facilities proposed.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	No facilities proposed		No facilities proposed	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 19

Geographic Area: Merrimac

Impact: Collection System/Land Use

The 1990 service area supports the plan for medium and industrial development. The additional service by 2020 may bring some pressure for development in areas planned for low density.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	Service to central Merrimack medium density and industrial areas		Additions to 1990 area serve low density area	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 20

Geographic Area: Merrimac

Impact: Land Modification/Land Use

The most significant impact is the use of 280 acres of land for S.I. by 1990 and 100 acres of land for S.I. by 2020. This land is planned primarily for open space.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due ~~to~~ location of facilities	T.P. in S.Merrimack, medium to low density area		No additional facilities planned	
Alternative 1	Same as above	T.P. closer to river	Change from low density	Same as above	No change
Alternatives 2-4	Same as above	No T.P.	Land available for planned use	Same as above	No change
Alternatives 5,6	Same as above	T.P. in S. Merrimack 280 acres S.I.	No change Change from low density & public & district open space	100 acres S.I.	Change from public and district open space

TABLE 21

Geographic Area: Methuen

Impact: Collection System/Land Use

Those areas of Methuen that are most developed are presently served by the GLSD. Alt 1-6 will add some areas that are presently planned for low density residential development. There might be some pressure for more intensive development in these areas.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	Service area includes low density areas		No additional facilities	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 22

Geographic Area: Methuen

Impact: Land Modification/Land Use

There are no facilities proposed.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	No facilities proposed		No facilities proposed	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 23

Geographic Area: Newbury

Impact: Collection System/Land Use

The service areas are compatible, there is no significant impact.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	Will serve industrial areas, medium, low density and commercial area		No expansion of service area	
Alternatives 1 - 6	Same as above	Same as above	No change	Same as above	No change

TABLE 24

Geographic Area: Newbury

Impact: Land Modification/Land Use

No facilities are proposed for Newbury, therefore there is no signigicant impact.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	No T. P. No L. A.		No facilities	
Alternatives 1 - 6	Same as above	Same as above	No change	Same as above	No change

TABLE 25

Geographic Area: Newburyport

Impact: Collection System/Land Use

The 1990 service area includes public and district open space and may create pressure for more development. Service to industrial areas supports the MVPC plan.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	Service to area in W. Newburyport that is desig.public & district open space. Service to industrial area in North.		Service to industrial area East of Rt.95	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 26

Geographic Area: Newburyport

Impact: Land Modification/Land Use

The EPA plan, and Alt 1, 5 & 6 propose a treatment plant in a medium density area. There is concern about use of waterfront property for this type of activity. Alt 2,3,4 propose a plant in low density area. There are no land application sites.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional land use plan due to location of facilities	T.P. on river in medium density area		No additional facilities	
Alternatives 1,5,6	Same as above	Same as above	No change	Same as above	No change
Alternatives 2,3,4	Same as above	T.P. located inland	change from low density area	Same as above	No change

TABLE 27

Geographic Area: North Andover

Impact: Collection System/Land Use

There may be some pressure to develop the public open space that is served but basically the service areas support the land use plan.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	North Central part of town-some public open space; low density, industrial		Will serve area planned for low density and district open space	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 28

Geographic Area: North Andover

Impact: Land Modification/Land Use.

There is minimal impact since the treatment plant (the only facility planned) is in the area of the airport and should not create any conflicts.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional land use plan due to location of facility	T. P. near Lowell Municipal Airport		No additional facilities	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 29

Geographic Area: Rowley

Impact: Collection System/Land Use

No service areas have been proposed for Rowley. This will be done at a later date if necessary.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	No service area		No service area	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 30

Geographic Area: Rowley

Impact: Land Modification/Land Use

Alternatives 1, 5, and 6 call for treatment plants in areas of public open space. This could affect the type of activities in those areas. The land application sites will use land designated as district open space.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	No T. P. No L. A.		No additional facilities	
Alternative 1	Same as above	T. P. in East Rowley	Change from public open space	Same as above	No change
Alternatives 2 - 4	Same as above	No T. P. No L. A.	No change	Same as above	No change
Alternatives 5, 6	Same as above	T. P. in West Rowley	Change from public open space	120 acres S. I. 200 acres S. I.	Change from district open space

TABLE 31

Geographic Area: Salisbury

Impact: Collection System/Land Use

Service areas include existing developed areas and would probably create pressure for more intensive development in areas planned for low density. Goals for commercial and industrial development will be supported.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan.	Service area will include low density and commercial areas		Service area will include low density and industrial areas	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 32

Geographic Area: Salisbury

Impact: Land Modification/Land Use

All planned facilities will use land planned for public open space. This is not inconsistent although some activities may be different.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	T.P. in area designated public open space		No additional facilities	
Alternatives 1-4	Same as above	Same as above	No change	Same as above	No change
Alternatives 5,6	Same as above	T.P. in same location as EPA Plan 110 acres R.I.	No change Public open space	Same as above	No change

TABLE 33

Geographic Area: West Newbury

Impact: Collection System/Land Use

No service area has been proposed because West Newbury does not need sewering now. Provisions are being made for future sewering if it is called for.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan.	No service area specified		No service area specified	
Alternatives 1-6	Same as above	Same as above	No change	Same as above	No change

TABLE 34

Geographic Area: West Newbury

Impact: Land Modification/Land Use

The major impact is use of 260 acres of land under Alternative 5 or 570 acres of land under Alternative 6 by 2020. This will use land designated for low density development.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities.	No. T.P. No. L.A.		No additional facilities	
Alternatives 1-4	Same as above	Same as above	No change	Same as above	No change
Alternative 5	Same as above	T.P.	Change from low density area	160 acres S.I. 100 acres S.I.	Change from low density
Alternative 6	Same as above	No T.P.	No change	160 acres S.I. 110 acres S.I. 300 acres S.I.	Change from low density

TABLE 35

Geographic Area: Billerica

Impact: Collection System/Land Use

The proposed service areas appear to be consistent with local programs and with NMAC plans.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	Includes corridors industrial park, development centers		adds service in some sub-urban areas	
Alternatives 1-5	Same as above	Same as above	No change	Same as above	No change

TABLE 36

Geographic Area: Billerica

Impact: Land Modification/Land Use

There will not be any significant land use impacts due to land modification since the existing treatment plant will be used and upgraded and the land application site will not be in Billerica.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	Existing T.P. in North Billerica in industrial area		No additional facilities	
Alternatives 1-4	Same as above	Same as above	No change	Same as above	No change
Alternative 5	Same as above	T.P. in North Billerica Land application in Concord Carlisle	No change	Same as above	No change

TABLE 37

Geographic Area: Chelmsford

Impact: Collection System/Land Use

The NMAC plan recommends sewering all of North Chelmsford by 1990 while the proposed alternative would not serve the entire area until after 1990. The triangular area not served at all under the alternative is currently developing and should be sewered eventually.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	Generally compatible Triangular area in south not sewered		Generally compatible Triangular area in South not sewered	
Alternatives 1-5	Same as above	Same as above	No change	Same as above	No change

TABLE 38

Geographic Area: Chelmsford

Impact: Land Modification/Land Use.

Alternative 1 calls for treatment plants to be located in areas presently planned for open space (North) and industrial use (South). Although the town would like a treatment plant, there is concern about the technical viability of the site in the North. There are no treatment plants or land application sites in Chelmsford under Alternatives 2-4, and therefore there is no change from the baseline. Alternative 5 includes the North treatment plant and would use S.I. 180 acres of land currently planned for suburban development.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	No T. P. No L. A.		No additional facilities	
Alternative 1	Same as above	T. P. in North and South Chelmsford	North- change from open space and recreation area South- change from industrial area	Same as above	No change
Alternative 2-4	Same as above	No T. P.	No change	Same as above	No change
Alternative 5	Same as above	T. P. in North Chelmsford 180 acres S.I.	1. Change from open space and recreation area 2. Expansion of land application into Carlisle	Same as above	No change

TABLE 39

Geographic Area: Dracut

Impact: Collection System/Land Use

The proposed service areas are generally consistent. Since East Dracut is considered a prime industrial development area, it should be entirely served by 1990. The proposed service areas do not call for service to most of West Dracut until 2020; however, this area does contain proposed 1990 corridor and development areas.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service areas with regional land use plan	Generally compatible does not serve industrial area in E. Dracut or proposed corridor and development areas		Generally compatible includes corridor and development areas	
Alternatives 1-5	Same as above	Same as above	No change	Same as above	No change

TABLE 40

Geographic Area: Dracut

Impact: Land Modification/Land Use

Although there are no facilities proposed for Dracut itself, an expansion of the Duck Island facility in Lowell would have impact on adjacent land uses in Dracut. This facility is compatible with NMAC plans.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional land use plan due to location of facilities	No facilities		No facilities	
Alternatives 1-5	Same as above	Same as above	No change	Same as above	No change

TABLE 41

Geographic Area: Dunstable

Impact: Collection System/Land Use

For the foreseeable future, septic tanks seem to be the most appropriate and desired means of wastewater disposal.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	No service area		No service area	
Alternatives 1-5	Same as above	Same as above	No change	Same as above	No change

TABLE 42

Geographic Area: Dunstable

Impact: Land Modification/Land Use

Alternative 5 will have the only major impact since it involves land application sites in potential suburban and town center areas. According to NMAC, the proposed 97 acre site for rapid infiltration may be a good source for construction materials and be unsuitable for land application on the basis of soil characteristics. The baseline and Alternatives 1-4 to not recommend any facilities.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	No T. P. No L. A.		No additional facilities	
Alternatives 1 - 4	Same as above	Same as above	No change	Same as above	No change
Alternative 5	Same as above	No T. P. 97 acres R.I. 100 acres R.I.	Change from potential industrial; Change from suburban area	125 acres R. I.	Change from town center, suburban, and open space areas

TABLE 45

Geographic Area: Pepperell

Impact: Collection System/Land Use

Recent re-zoning provides for lower density in north central, western and southern sections. Proposed service (particularly for 2020) might create pressure for higher density in these areas. The town would like to develop industry north of the proposed T. P. site but this is not in the proposed service area.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	Desirable development area north of T. P. is not served		Service area is larger than necessary for present plans	
Alternatives 1-5	Same as above	Same as above	No change	Same as above	No change

TABLE 46

Geographic Area: Pepperell

Impact: Land Modification/Land Use

Alternatives 1 and 2 will not cause any change from the baseline. Alternatives 3 and 4 will permit the designated T.P. site to remain in industrial use. The T.P. site for alternative 5 will not cause any change from the baseline. The 140 acres for R.I. in 1990 will use land intended primarily for industrial use and some suburban and open space use. The additional 40 acres to be used by 2020 will use land in suburban and open space areas.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	T. P. located in E. Pepperell gravel pit zoned for industry		T. P. located in E. Pepperell gravel pit zoned for ind.	
Alternatives 1, 2	Same as above	Same as above	No change	Same as above	No change
Alternatives 3, 4	Same as above	No T. P.	Site remains intact for indust. use	No T. P.	Site remains intact for indust. use
Alternative 5	Same as above	T. P. in E. Pepperell 140 acres R.I.	No change Change from indust; suburban and open space areas	T. P. in E. Pepperell 40 acres R.I.	No change Change from suburban and open space areas

TABLE 49

Geographic Area: Tyngsborough

Impact: Collection System/Land Use

Service areas are consistent with NMAC plans.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service areas with regional land use plans	Most of E. Tyngsboro planned suburban corridor, open space		Service expand west to central Tyngsboro incl. suburban, corridor, open sp	
Alternatives 1-5	Same as above	Same as above	No change	Same as above	No change

TABLE 50

Geographic Area: Tyngsborough

Impact: Land Modification/Land Use

The only facility located in Tyngsborough will be a 210 acre R.I. site that will use land planned for an industrial park.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	No T. P. No L. A.		No additional facilities	
Alternatives 1-4	Same as above	Same as above	No change	Same as above	No change
Alternative 5	Same as above	210 acres R.I.	Change from industrial park	Same as above	No change

TABLE 51

Geographic Area: Westford

Impact: Collection System/Land Use

The limited service areas could be obstacles to town development goals. Development areas should all be served. According to NMAC officials the town wants to develop industry, business and possibly apartments at the intersection of Routes 495 and 110.* This areas will not be served under any of the alternatives.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Compatibility of service area with regional land use plan	Service area is smaller than NMAC Plan service area		Some extension of 1990 areas but still smaller than NMAC plan	
Alternatives 1 - 5	Same as above	Same as above	No change	Same as above	No change

* Letter from Joseph P. Hannon, NMAC Director, to NMAC Commissioners and Alternates, January 7, 1974, p.4.

TABLE 52

Geographic Area: Westford

Impact: Land Modification/Land Use

Alternatives 1-4 will not cause any changes from the baseline. Alternative 5 will take approximately 370 acres of land that is planned for some form of development by 1990 and 110 acres planned for some form of development by 2020. In the case of neighborhood centers and development corridors the land application sites would be incompatible with the planned uses.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regional plan due to location of facilities	No T.P. No L. A.		No additional facilities	
Alternatives 1, 2, 3, 4	Same as above	No T. P. No L. A.	No change	Same as above	No change
Alternative 5	Same as above	No T. P. 70 acres R. I. 80 acres R. I. 100 acres S. I. 120 acres S. I. 130 acres S. I. 160 acres S. I.	Change from neighborhood center suburban area. Change from development corridor Change from development corridor Change from suburban area Change from regional park Change from recreation and open space	110 acres S.I.	Change from development corridor

TABLE 53

Geographic Area: Lancaster, Bolton, Ft. Devens

Impact: Land Modification/Land Use

Of the 460 acres of land involved, 160 acres are in Ft. Devens and 300 acres are in Lancaster and Bolton. The land is designated for public use in Lancaster and industrial use in Bolton. The Dept. of the Army will probably retain possession of the land as a training area unless it is given to the towns for use as a public R.I. site.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Change from land use specified in regiaonl plan due to location of facilities	No T.P. No L.A.		No additional facilities	
Alternatives 1-4	Same as above	Same as above	No change	Same as above	No change
Alternative 5	Same as above	160 acres R.I. (Ft. Devens) 300 acres R.I.	Public use and industrial	Change from public use	No change

DATA SOURCES

(1) Regional Land Use Plan, Central Merrimack Valley Regional Planning District, 1970.

(2) Central Merrimack Valley Regional Planning District Generalized Land Use, 1970.

(3) Merrimack Wastewater Management Study, Northern Middlesex Area Commission, October 1, 1973.

(4) Northern Middlesex Area Commission Maps:

Existing Land Use, 1973
Existing Zoning, 1973
Future Land Use

(5) Review of Engineer Submissions for the Merrimack Wastewater Management Study, NMAC, January 7, 1974.

(6) Community Profiles, MVPC, January 7, 1974.

(7) Letter from Joseph P. Hannon, NMAC Director, to NMAC Commissioners and Alternates, January 7, 1974.

E. IMPACT CATEGORY: HOUSING

Plan Actions specified in the engineering alternatives that will affect housing in the study area are Collection System and Land Modification.

Collection System

Collection systems have direct impacts upon housing in the following principal ways:

(1) the location of collection systems affects locations where single-family units can be built if soils are inadequate for on-site disposal;

(2) interceptor corridors are more favorable for high density housing (as well as other high intensity uses);

(3) land values often rise near interceptor corridors and low-income housing in these areas may be displaced by uses with higher economic values.

Since the areas proposed for sewering are alike in all of the Alternate Plans, no differential impact would be expected upon single-family housing. There also appears to be relatively little differential impact of interceptor corridors with regard to congruence with existing moderate and high density residential areas.

All alternatives, however, would not only sharply upgrade water quality in the Merrimack River but also create interceptor corridors near the river where rising land values might occur. Many of these areas are in older riverfront cities such as Lawrence and Lowell, and are now occupied by low-income housing. They could therefore be threatened to some extent with displacement by higher economic uses.

The low and moderate-income housing needs[1] of the affected communities are shown in the following table.

		Units
NMAC:	Billerica	1541
	Chelmsford	1051
	Dracut	905
	Dunstable	34
	Lowell	8066
	Pepperell	468
	Tewksbury	845
	Tyngsborough	286
	Westford	384

[1] Source: Table 7, 1974 Report on Housing Needs and Programs, Final Review Draft, March 25, 1974. Commonwealth of Massachusetts, Department of Community Affairs.

		Units
MVPC:	Amesbury	953
	Andover	1584
	Boxford	186
	Georgetown	217
	Groveland	287
	Haverhill	4558
	Lawrence	5299
	Merrimack	306
	Methuem	2609
	Newbury	278
	Newburyport	1505
	North Andover	1071
	Rowley	160
	Salisbury	450
	West Newbury	174

The communities with the greatest low- and moderate-income housing needs are Lowell, Lawrence and Haverhill, all of which might expect some loss or displacement due to rising land values. However, it is anticipated that this loss could be more than compensated for by the additional units in other communities that could be enabled by the new interceptors and sewage systems.

Land Modification

The acquisition and modification of land parcels for the construction of wastewater treatment facilities is the other major way that housing in the study area stands to be affected. In no instance is the construction of treatment plants, pumping stations or pipelines expected to require the relocation of residences. Sites tentatively selected for land application of treated effluent, however, do include several residential parcels in both the Northern Middlesex Area and the Merrimack Valley Planning Area. Twenty residences are involved by Alternative 5 in NMAC; and six and eight residences by Alternatives 5 and 6, respectively, in MVPC. It should be noted that, for the land application sites presently specified, these are the minimum numbers of residential relocations that would be required. This is because the count of houses affected was based on United States Geological Survey maps printed in 1966, and consequently additional houses may have been built on these sites since that time, and more may be added before the land is actually acquired for conversion to land treatment use. Although the entire acreage for land application sites will not be needed until 2020 according to wastewater flow projections, all residences on the sites will have been purchased by 1990, so that it is assumed that relocation will have occurred by that date.

Unfortunately, we have no data regarding the demographic characteristics of the households that stand to be affected, and thus are unable to address the issue of whether the impact will be concentrated on any particular socio-economic group, e.g., low income and/or minority persons. It should be pointed out that the land application sites in question are only tentative proposals, based on preliminary feasibility studies of soil characteristics and required acreages. It could well be that further investigation will identify alternate sites in some cases.

Exact purchase prices and relocation assistance monies that will be paid to the households affected cannot, of course, be calculated at the present time. For purposes of determining the real estate costs of each alternative, engineers have used an acquisition price of $40,000 per residence, and an additional $5,000 each in relocation assistance. It is also not possible to quantify the significant social costs that will be incurred, in terms of inconvenience to the inhabitants and their forced separation from neighbors and places that have been "home" to them. However, unless the number of homes involved is substantially larger than the known figures cites above, it is not anticipated that the households involved will encounter serious problems in finding suitable replacement housing.

TABLE 54

Geographic Area: Merrimack Valley Planning Commission
Northern Middlesex Area Commission

Impact: Land Modification/Housing

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Houses displaced by modification of land for treatment facilities	No displacements identified		No displacements identified	
Alternatives 1-4 (water-oriented systems)	Same as above	Same as above	No change	Same as above	No change
Alternative 5 (land-decentralized)	Same as above	MVPC 6 houses NMAC 20 houses	MVPC 6 houses NMAC 20 houses	MVPC 6 houses NMAC 20 houses	MVPC 6 houses NMAC 20 houses
Alternative 6 (land-decentralized)	Same as above	MVPC 8 houses NMAC not applicable	MVPC 8 houses	MVPC 8 houses	MVPC 8 houses

DATA SOURCES

1. Table 7, 1974 Report on Housing Needs and Programs, Final Review Draft, March 25, 1974. Commonwealth of Massachusetts, Department of Community Affairs.

2. U. S. Geological Survey Maps of the Study Area, generally dated 1966.

F. IMPACT CATEGORY: TRANSPORTATION

The impact of the proposed wastewater management activities on transportation was not considered a significant impact by either of the Regional Planning Agencies. The only expected impact of importance is the short term effect of construction of interceptors and force mains since these follow and/or cross roads in many towns. There will be virtually no disruption of traffic on interstate or state highways since tunneling under these highways is required. Construction will occur throughout the two regions over a 3-4 year period; however, construction on any specific street will take about 1 year. This will create tie-ups during peak travel times, but inconvenience can be minimized through towns where large sections of roads and/or developed areas will be involved. The following towns will experience some transportation impact:

MERRIMACK VALLEY PLANNING COMMISSION

	Town	Street	Alternative
1.	Salisbury	Route 110 and 1A	All
2.	Newburyport	Route 1A	3, 4
		Low Street	All
		Storey Street	All
		Pasture Road	All
		Parker Street	All
3.	Newbury	High Road	All
4.	Rowley	Main Street	All
		Haverhill Street	All
5.	Georgetown	Andover Street	5, 6
		East Main Street	5, 6
6.	West Newbury	Route 113	All
7.	Amesbury	Pleasant Valley Road	All
		Middle Road	1
		Haverhill Road	3, 4

8.	Merrimac	Main Street	5
		Peabody Road	5
9.	Haverhill	Water Street	All
		East Street	5, 6
		S. Main Street	3, 4
10.	North Andover	Salem Street	All
11.	Lawrence	Riverside Drive	All
		Water Street	All

NORTHERN MIDDLESEX AREA COMMISSION

	Town	Street	Alternative
1.	Lowell	Middlesex	2, 3, 5
		Pawtucket	All
		Merrimack Lane	All
		Lawrence Street	3, 5
2.	Tyngsborough	Middlesex Turnpike	All
		Kendall Road	All
3.	Billerica	Bridge Street	3, 5, 4
		Rogers Street	3, 5, 4
4.	Pepperell	Lowell Road	All
5.	Westford	Concord Road	5
		Littleton Road	5
		Chelmsford Road	5
6.	Dunstable	Lowell Street	All
7.	Tewksbury	Trull Street	4

Those towns where the affected roads are located in high density business districts will experience the most significant impact. In MVPC these include: Salisbury, Newburyport, and Haverhill. in NMAC the affected towns are Lowell, Westford and Chelmsford. Nevertheless, representatives of the regional planning agencies do not expect significant disruption of commercial activity.

TABLE 55

Geographic Area: Merrimack Valley Planning Commission

Impact: Construction/Transportation

The following towns will experience some disruption and inconvenience due to construction: Salisbury, Newburyport, Newbury, Rowley, Georgetown, West Newbury, Amesbury, Merrimac, Haverhill, Lawrence.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan	Disruption of road traffic	Not known at this time		No long term impact	
Alternative 1	Same as above	All towns mentioned above except Georgetown and Merrimac	Unknown	Same as above	No change
Alternatives 2 - 4	Same as above	Same as above	Unknown	Same as above	No change
Alternatives 5, 6	Same as above	All towns mentioned above	Unknown	Same as above	No change

TABLE 56

Geographic Area: Northern Middlesex Area Commission

Impact: Construction/Transportation

The following towns will experience some disruption and inconvenience: Lowell, Tyngsborough, Billerica, Pepperell, Westford, Dunstable, Tewksbury.

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan	Disruption of road traffic	Not known at this time		No long term impact	
Alternatives 1, 2	Same as above	All towns mentioned above except Billerica, Westford and Tewksbury	Unknown	Same as above	No change
Alternative 3	Same as above	All towns mentioned above except Westford and Tewksbury	Unknown	Same as above	No change
Alternative 4	Same as above	All towns mentioned above except Westford	Unknown	Same as above	No change
Alternative 5	Same as above	All towns mentioned above except Tewksbury	Unknown	Same as above	No change

DATA SOURCES
(Transportation)

U. S. Geological Survey Maps of the Study Area, generally dated 1966.

G. IMPACT CATEGORY: RECREATION

The plan actions of proposed engineering alternatives that could have significant impacts on recreation opportunities in the study areas are: (1) land modification, wherein land areas that are existing or potential recreation sites are proposed for treatment plant or effluent disposal sites; and (2) specified objectives regarding the ultimate level of water quality to be achieved in the Merrimack River Basin.

1. Recreation Impacts of Land Modification for Treatment Facilities

The present analysis addresses recreation impacts of two types of treatment facilities: sewage treatment plants and land application sites. The methodology applied in the analysis involved: (1) identification of cases where the proposed location of a facility was land either currently in use or planned as recreation or open space; and (2) assessment of the implications that placement of the facility would have for recreation opportunities in that vicinity.

There are a number of factors that will determine the nature and magnitude of impacts of treatment facilities on recreation that must be considered: the physical characteristics of the facility and its amenability to multiple (specifically recreational) use; the proportion of total available recreation-oriented land that is involved in a given community; and potential users' attitudes vis-a-vis the attractiveness of a treatment facility as a recreation resource.

As to the first factor, physical characteristics of the facility, spray irrigation sites are relatively better suited to recreational use than are either rapid infiltration or treatment plant sites, as a lesser extent of re-landscaping of the site need be involved, and a larger proportion of the total site is available for recreational use. In rapid infiltration sites, probably only pathways between flooding areas would be available for recreational use. The recreational potential of treatment plants depends almost entirely on additional expenditures to provide landscaping around the facility that would be suitable for recreation. Indeed, given unlimited funds for developing recreational facilities in conjunction with treatment facilities, any of the three types discussed here could provide substantial recreation benefit. However, the spray irrigation sites are the most intrinsically suitable for recreation, without elaborate development for that specific purpose. (An evaluation of the recreational impacts of treatment facilities from the aesthetic point of view is contained in a separate report, Appendix IV-C.

With respect to the factor of total available recreation-oriented land, it should be pointed out that the areas involved in the

land application proposals are not formal recreation areas, as such, but undeveloped areas designated in regional plans for recreation/open space use suitable for non-intensive recreation. The issue of whether the acreage needed for a facility site would be "removed" from the community or region's inventory of recreation areas is, in the case of spray irrigation sites, largely a matter of people's attitudes about using the site for recreation; spray irrigation is considered by some people as a benefit to the community, in terms of preserving an open space parcel for either recreational or agricultural use; others might find the concept of such multiple use repugnant because of negative associations with the primary use of the land effluent disposal. In the case of treatment plants, obviously, the site of the physical facility would be removed, and permanently so, although the acreage consumed is far less than for land application sites. Although the acreage involved in rapid infiltration sites would not necessarily be permanently removed, a significant proportion of each such site would not be available for recreation as long as the site is used for effluent disposal.

The charts below present the instances identified where proposed treatment facilities are located in recreation-oriented areas:

(1) Treatment Plants

Region	Community	Alternatives Involved	Designation of Area in Regional Plan*
MVPC	Salisbury	1-6	Public Open Space
	Rowley	1,5,6	Public Open Space
NMAC	Chelmsford (North)	1 & 5	Open Space & Recreation

(2) Rapid Infiltration Sites

Region	Community	Alternatives Involved	Total Acres	Designation of Area in Regional Plan*
MVPC	Boxford	5 & 6	115	Public & District Open Space
	Salisbury	5 & 6	110	Public Open Space
NMAC	Pepperell	5	40	Suburban & Open Space

(3) Spray Irrigation Sites

Region	Community	Alternatives Involved	Total Acres	Designation of Area in Regional Plan*
MVPC	Boxford	5	105	Public & District Open Space
	"	5 & 6	360	Public & District Open Space
	Georgetown	5 & 6	300	District Open Space
	Merrimac	5	380	Low Density Area, & Public & District Open Space
	Rowley	5 & 6	320	District Open Space
NMAC	Westford	5	130	Proposed Regional Park
	"	5	160	Recreation & Open Space

As indicated in the charts above, by far the most acreage involved in the use of recreation-oriented land for treatment facilities is that proposed for spray irrigation facilities, which are not incompatible with open space plans for these areas. Indeed, use of the sites for spray irrigation can be considered a recreation benefit, as opposed to a merely neutral impact, in that it could help preserve for recreational use a site that might otherwise be developed.

The rapid infiltration sites would have relatively neutral impacts; although they do not consume a significant proportion of either community's open space, they probably will afford a negligible recreation opportunity, and might be considered aesthetically unattractive by potential users.

Treatment plants in Salisbury and Rowley are expected to have a negligible impact on recreation, as the proposed sites would consume but very small parcels in what are large open space areas. The North Chelmsford treatment plant would have a significant negative impact on recreation only if the immediate vicinity, now designated for "Open Space and Recreation," is slated for particular recreation uses for which that site is uniquely suited; if open space is the expected use, then the conflict would not be a serious one.

* For an explanation of these terms as used in regional land use plans, see introduction to chapter on Land Use.

2. Recreation Impacts of Water Quality Objectives

In terms of the impact of expected water quality changes on recreation, the greatest differential effects among the proposed engineering alternatives would be between the State Implementation Plan (proposing secondary treatment) on the one hand, and the set of alternatives proposing advanced treatment throughout the basin (Alternatives 1-6), on the other hand. The analysis of recreation impacts associated with water quality improvements that are presented here, is divided into two sections, addressing the two-fold purpose of the present study: (a) to aid in the selection of the preferred plan from among the engineering alternatives proposed by the Corps of Engineers; and (b) to determine whether there is justification, in terms of reasonably expectable benefits, for implementing basin-wide AWT systems rather than SWT systems as currently proposed in the State Implementation Plan.

a. Assessment of the AWT Alternatives

The set of engineering alternatives in this study are aimed at fulfilling the requirements of current Federal legislation as contained in PL92-500, whereby fishable, swimmable waters are to be attained by 1983 and zero discharge of pollutants is the goal for 1985. Although the present analysis is based on the tentative assumption that the set of AWT alternatives will accomplish these objectives, we must strongly qualify this assumption by pointing out that there are several factors which have not as yet been thoroughly accounted for, that will play a substantial role in determining the level of water quality achieved and the corresponding recreation benefits. These factors are: control of non-point sources of pollution, the operational reliability of AWT plants, and the enforcement of industrial treatment regulations. This qualification applies to all estimates of recreation benefits contained in the following section.

Because water quality changes are the major basis for assessing relative recreation benefits of the different alternatives, the findings of the biological study of anticipated water quality impacts are used here to rank the alternatives. A detailed discussion of the technical factors that were considered in reaching these conclusions is contained in the separate study on aquatic impacts, Appendix IV-B.

According to the biological assessment, the land-oriented alternatives are the most preferable engineering proposals, since land disposal of treated effluent avoids the discharge into receiving waters of chlorine, which could adversely affect aquatic life. Following the land-oriented alternatives, in decreasing order of preference are Alternatives 1, 2, 3, and 4; that is, the water-oriented alternatives are ranked according to degree of decentralization, the most decentralized being most preferable. The basis for this conclusion is that decentralization minimizes the volume of effluent discharged at any one point, and hence reduces the hazards associated with discharged chlorine and plant breakdowns.

This ranking applies to the main stem of the river, where final treatment prior to discharge is in all cases advanced treatment. In the estuary however, the alternatives vary both as to the level of final treatment contemplated and as to location of outfalls (deep-ocean vs. estuary); therefore, the ranking of alternatives on the basis of water quality impacts in this area is not consistent with the ranking for the main stem. The ranking of alternatives in the estuary is the same as for the impact category Commercial Fisheries, that is:

Rank	Alternative	Rationale
1	Alt. 2	Deep-ocean outfall provided
2	Alt. 3&4	Estuary outfall with prior AWT
3	Alt. 5&6	Estuary outfall for Newburyport with SWT
4	Alt. 1	Estuary outfall for both Newburyport & Salisbury; treatment level is SWT

However, it is in the mainstem that a greater magnitude of change in recreational opportunities can be expected, because of the larger difference in existing recreational opportunities between the mainstem and the estuary. The estuary today is an active recreation resource where sport fishing and boating thrive; valuable game fish are caught and eaten. In contrast, water pollution in the mainstem of the river has severely reduced the recreational potential of the water--i.e., aesthetic quality and capacity to support desirable game fish.

On this basis, then, as far as recreation benefits are concerned, we would rate the alternatives overall according to their effects on the mainstem of the Merrimack, with the qualification that advanced treatement, and/or a deep-ocean outfall in the estuary area would also be desirable.

b. Assessment of Recreational Benefits under the EPA State Implementation Plan (SWT) vs. The Advanced Wastewater Treatment Alternatives

Although there is certainly a range of quality levels toward which a given wastewater management plan might be aimed, the assessment which follows is based on the difference made, in terms of recreation activity, between implementing secondary wastewater treatment (SWT) systems as proposed by the EPA State Implementation Plan and implementing advanced wastewater treatment (AWT) systems as proposed by the six alternatives designed to address Federal requirements and goals.

There is clearly a close relationship between water quality and people's use of water-based and water-related facilities for recreational purposes; certain activities may reasonably be expected to increase greatly with improvements in water quality. The following section delineates estimates, subject to the qualification noted above, of the increased recreation activity that can be expected with implementation of SWT systems versus AWT systems in the study area.

It is important to point out that, given the present state of the art in recreational forecasting, estimates such as those given below are admittedly crude. Nevertheless, the direction of the changes is clear, and current research in demand forecasting methodology holds the promise that these estimates can be made more precise as new techniques become available. For the present, the estimates below provide gross measures of the order of magnitude of expected changes in recreation demand.

Estimates of Future Recreation Demand

The recreation activities affected by water quality can be divided into two groups, water-based and water-related. The water-based group includes swimming, water skiing, power boating, non-power boating, game gishing, and general fishing. The water-related group includes picnicking, hiking, bicycling, camping, sightseeing, and horseback riding. Scarcity of data limited our analysis to two activities from each group; however, the activities selected -- swimming, boating, picnicking, and camping -- are among the most prevalent water-associated recreational pursuits, and it is reasonable to expect that they are illustrative of water-associated activities in general.

The table on the following page indicates the demand for these four recreational activities at three points in time: 1970, 1990 and 2020, all based on current participation rates and current estimates of population growth. It is important to point out the major assumptions and qualifications underlying these estimates of recreation demand. First, demand in the two planning areas under study is assumed

TABLE 57: ESTIMATES OF FUTURE RECREATION DEMANDS

Merrimack Valley Planning Commission*

Activity	Activity Days		
		With Advanced Wastewater Treatment	
	1970	1990	2020
Swimming	5,471,894	(1.3) (2.0) = (2.6) 14,226,924	(1.5) (2.0) = (3.0) 16,415,682
Picnicking	2,623,796	(1.3) (1.25) = (1.625) 4,263,669	(1.5) (1.25) = (1.875) 4,919,618
Camping	2,888,107	(1.3) (1.25) = (1.625) 4,693,174	(1.5) (1.25) = (1.875) 5,415,201
Boating	3,079,603	(1.3) (1.5) = (1.95) 6,005,226	(1.5) (1.5) = (2.25) 6,929,107

Northern Middlesex Area Commission*

Activity	Activity Days		
		With Advanced Wastewater Treatment	
	1970	1990	2020
Swimming	4,808,634	(1.5) (2.0) = (3.0) 14,425,902	(1.7) (2.0) = (3.4) 16,349,355
Picnicking	2,305,760	(1.5) (1.25) = (1.875) 4,323,300	(1.7) (1.25) = (2.125) 4,899,740
Camping	2,538,033	(1.5) (1.25) = (1.875) 4,758,812	(1.7) (1.25) = (2.125) 5,393,320
Boating	2,706,318	(1.5) (1.5) = (2.25) 6,089,216	(1.7) (1.5) = (2.55) 6,901.111

* The number in the first set of parentheses is the projected growth rate, and the number in the second set of parentheses is the estimated participation rate growth factor.

to grow in proportion to population growth in these areas. In the absence of any data permitting a more precise assumption, this basis for projection would seem reasonable. Second, current participation rates for the recreational activities shown in the figure are assumed to hold in later years. This assumption is dubious since most cross-sectional studies of participation rates at different points in time indicate that there has been a secular increase in such rates over time. (This has been in part the result of the entrance of previous non-participants into recreational activities.) Hence, this assumption is somewhat conservative. Third, activity day estimates have been adjusted upward by a factor of 2.0 for swimming, 1.5 for boating, and 1.25 each for camping and picnicking to reflect the differential effects of advanced wastewater treatment and secondary wastewater treatment. The absolute numbers there are fairly arbitrarily chosen; what is important are the relative weights assigned to the different activities, which should be maintained regardless of whether the absolute numbers are revised subsequently. The elasticity of recreational activities with respect to water quality improvements is at present unknown. To the extent that these adjustment factors are overly optimistic, they are tempered by the overly conservative estimates that result from using present, unadjusted participation rates. In any event, as new data become available, it will be a relatively simple matter to recalculate the demand estimates for these and other recreational activities.

Estimates of Future Recreation Opportunities

Another measure of the changes that may be induced in recreation demand by improvements in water quality consists of a simple ratio of the number of potentially available activities with SWT and AWT to the number of presently available recreational activities. This measure is arrived at by substituting into the following formula:

$$\text{Recreation activities} = \frac{PWB + PWR + EWB + EWR}{EWB + EWR}$$

where

PWB = potential water-based activities

PWR = potential water-related activities

EWB = existing water-based activities

EWR = existing water-related activities

An illustration of this measure is given by the comparison of the twelve recreational activities below under conditions of SWT and AWT.

Water-Based Recreation Activities	Water-Related Recreation Activities
Swimming	Picnicking
Water Skiing	Hiking
Power boating	Bicycling
Non-power boating	Camping
Game fishing	Sightseeing
General fishing	Horseback riding

Table 58 below indicates that the water-based activities -- swimming, water skiing, and game and general fishing -- become feasible (both safe and desirable) with AWT. On the other hand, all of the water-related activities are feasible with both SWT and AWT, although some (such as picknicking and camping) may increase with AWT because of the availability of swimming or water skiing. Hence, the index represents a minimum estimate of change. Substitution of these data into the formula yields a ratio of 1.5, indicating an increase of 50% in the kinds of recreational activities that can take place with AWT as compared with SWT. Of course, this index is not meant to be a precise indicator. Further precision would require weighting the components by expected increases in activity days rather than simply using categories of activities. But given the present dearth of accurate data, this measure serves at least to indicate the direction of the changes to be expected with improvements in water quality, and further provides a crude quantitative estimate of the magnitude of the change.

Qualitative Changes in Recreation Demand

Because precise estimates of recreation demand are impossible to calculate from present data sources and available forecasting methodologies, the quantitative estimates above are at best gross indicators. It is important, therefore, to emphasize two additional points -- recreation quality changes and the interrelationships between increases in recreation activities and increases in demands for service sector personnel.

Quality Changes. As we have seen, the progression from secondary wastewater treatment to advanced wastewater treatment involves not only an increase in currently practiced recreational activities but also the creation of additional opportunities. Such additional opportunities have a

favorable impact on the quality of the recreation experience as a whole. For example, some amount of fishing already takes place in the polluted waters of the Merrimack, although the consumption of fish caught is likely to be a disagreeable experience at best and a highly dangerous one at worst. Progression from SWT to AWT would enable fishermen to enjoy the fruits of their labors and not simply the fishing experience itself, hence resulting in an improvement in the quality of the experience offered under conditions of SWT. Such quality improvement could be expected to increase the participation in fishing in Merrimack waters. In addition, with AWT a greater variety of species of fish could exist in the area, a circumstance which would further increase participation rates and, presumably, the enjoyment of the individual fisherman.

As a further illustration of the kind of quality changes that may be expected to occur, let us briefly consider the kind of fishing that would be available with SWT versus AWT. With SWT a slight increase in game fish (e.g., largemouth bass, chain pickeral, white perch) and pan fish (e.g., pumpkinseed sunfish, bluegill, yellow perch) may be expected in the mainstem. However, from a public health standpoint, concentration of toxic materials in these fish would still be likely to present a problem. Since Atlantic salmon spawn in the upper reaches of the river, SWT would probably permit a return of the salmon to the Merrimack, provided that efforts to restore fish ladders at dam sites are successful. The American shad will spawn in the lower reaches of the Merrimack, and SWT may not be adequate to overcome the dissolved oxygen problem in conjunction with low flows.

With AWT, salmon and shad would be expected to gain a stronger foothold and be safely edible as well. Furthermore, an increase in the diversity of the resident fish populations will occur. Largemouth bass, a game fish highly desirable to anglers, would flourish, and increases would also occur in the population of general pan and forage fish. As a related development, rough fish such as the white sucker, brown bullhead and carp, now the predominant residents of the Massachusetts portion of the river, are expected to decrease in number.

Effect on Demand for Service Sector Personnel. The increase in the quantity and quality of recreational activities available in the basin, because it will result in greater participation in and demand for recreational resources, can be expected to increase accordingly the demand for recreation-related services. Increased demand for such services as restaurants, fast-food establishments, fishing equipment sales and rentals, and marinas, etc., will consequently increase employment in these businesses.

TABLE 58

Geographic Area: Merrimack Valley Planning Commission

Impact: Water Quality/Recreation

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline: SWT (EPA State Implementation Plan)	Activity Days				
	Swimming	7,113,462		8,207,841	
	Picnicking	3,752,028		4,329,263	
	Camping	4,129,993		4,765,377	
	Boating	5,004,354		5,774,256	
Alternatives 1-5 AWT	Activity Days				
	Swimming	14,226,924	7,113,462	16,415,682	8,207,841
	Picnicking	4,263,669	511,641	4,919,618	590,355
	Camping	4,693,174	563,181	5,415,201	649,824
	Boating	6,005,226	1,000,872	6,929,107	1,154,851

TABLE 59

Geographic Area: Northern Middlesex Area Commission

Impact: Water Quality/Recreation

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline: SWT (EPA State Implementation Plan)	Activity Days				
	Swimming	7,212,951		8,174,678	
	Picnicking	3,804,504		4,311,771	
	Camping	4,187,754		4,746,122	
	Boating	5,074,346		5,750,926	
Alternatives 1-5 AWT	Activity Days				
	Swimming	14,425,902	7,212,951	16,349,355	8,174,678
	Picnicking	4,323,300	518,796	4,899,740	587,969
	Camping	4,758,812	571,058	5,393,320	647,198
	Boating	6,089,216	1,014,870	6,901.111	1,150,185

DATA SOURCES

(Recreation)

(1) Alternatives for Merrimack Wastewater Management: Information Packet for Mid-State Public Meetings. April, 1974.

(2) Bridges, Colton H., "New Life for the Merrimack." Massachusetts Wildlife (Westboro, Mass: Mass. Division of Fisheries and Game, Jan. - Feb., 1974).

(3) The Economic Impact of Recreation-Tourism in the Connecticut River Basin (Chilton Research Services for the Department of the Army, New England Division, Corps of Engineers, Sept., 1968).

(4) Environmental Evaluation System for Water Quality Management Planning (Columbus: Battelle Columbus Laboratories, Feb., 1973).

(5) Massachusetts Outdoor Recreation Plan: Eastern Massachusetts Supplement. (Boston: Massachusetts Department of Natural Resources, Dec., 1972).

(6) "Socio-Economic Profile of the Basin," (Draft report prepared by the Massachusetts Department of Commerce and Development, Massachusetts Department of Community Affairs, and the U. S. Army Corps of Engineers, New England Division, Spring, 1974).

H. IMPACT CATEGORY: MANUFACTURING

This section will deal with the effect of expenditures for advanced wastewater treatment on firms in the manufacturing sector. The three plan actions which will have an effect on manufacturing are (1) capital cost funding, (2) private abatement actions, and (3) operations. Manufacturing firms have the option of treating their wastewater discharge themselves or of paying for treatment by the municipal or regional treatment facilities. In the latter case, firms must perform whatever pre-treatment is required to make their wastewater compatible with domestic or municipal effluent. Thus, depending on the choices of the firms, their abatement actions will have an impact, over and above, or in place of, the share they would be charged of the capital and operating costs of the public treatment facilities. However, due to the complexity of the data on costs of private treatment systems, we have gathered cost data only on the public facilities, and assumed that private facilities will have similar impacts.

Manufacturing impacts can be expected to be limited if industrial abatement regulations are enacted on a nationwide basis. If all firms in an industry are simultaneously affected by roughly similar cost factors, and particularly if these costs are a relatively small proportion of total production cost, competitive positions of individual firms will be little changed.

The cost of compliance -- whether incurred through facilities modifications or externally purchased treatment -- can be expected in the long term to be passed on to the consumer. Profits may be reduced in the short term, especially in firms with higher than average changeover costs, to avert negative consumer reaction to a price increase. Total sales, by firm or industry, should not be significantly affected. It is likely that the requirement for pre-treatment of waste discharge will also reduce the resources available for capital investment and expansion. This would reduce the rate of growth in some sectors for a short period while pre-treatment equipment is being installed.

If there are no substantial changes in competitive position, the treatment requirements should have no effect on firm migration. Any initial effects from a lagged implementation (e.g., abatement enforced in Massachusetts before Mississippi) should even out by 1990. Similarly, if costs are passed on to the consumer, the only impact on local industry will be a small corresponding increase in total revenue and value added.

Significant negative impacts would occur in industries with strong foreign competition (e.g., leather). However, since these industries are for the most part already protected to some degree by

tariff systems, the extent of the impact will be determined more by public policy than by the economics of the situation. Impact from loss of competitive position vis-a-vis foreign industry is therefore excluded from the present analysis.

This leaves two situations in which industries could be affected by the proposed alternatives. First, costs of compliance for a particular firm might be so much higher than the average for the industry that the firm's competitive position would be worsened. Second, a firm's current operating position might be so weak that it could not bear the initial changeover costs, even knowing that such costs could ultimately be passed on. The first situation would certainly lead to a loss in profits and quite likely to a major cutback or closing. The second situation would probably lead to a plant closing.

Because these possible impacts depend on conditions facing individual firms -- conditions generally not identifiable from publicly available data -- it is impossible to use an impact estimation formula. There are no data available on the financial or operating conditions of individual area firms. Therefore, we cannot determine which firms have the older or more polluting technology, or which have the weakest profit positions, or which have declining sales or related problems. Without such data there is no accurate way to predict which individual firms will be able to survive the short-run stress of paying for wastewater treatment.

A four-step methodology is used here to arrive at rough impact estimates under these circumstances.

(1) The cost of public wastewater treatment was estimated on a per unit of flow basis.

(2) Using data on the wastewater discharge of different industrial firms in the study area, the firms were grouped according to their waste burden.

(3) Annual treatment costs for firms in each group were calculated; and local planners and businessmen were contacted to obtain estimates of the seriousness of the cost burden to area firms.

(4) Assumptions were then made regarding the maximum percentage of jobs in each group of firms that would be seriously threatened by implementation of advanced wastewater treatment systems. These percentages were applied to employment figures for each group of firms to calculate maximum total employment impacts for both planning regions in the study area. Although industrial profits and capital investment plans will also

certainly be affected, employment is the only impact for which data on these firms now exist.

Several points must be emphasized with respect to the resulting impact estimates:

- These are estimates of the maximum potential employment impact, rather than the impact which would realistically be expected. Given available data, there is no way to predict the expected impact.
- These maximum estimates are based on assumptions about the percent job loss which might occur in different categories of firms. While these assumptions appear reasonable, other reasonable assumptions could be made that would generate different impact results. No quantitative or firm-specific survey data area available at this time on which to base other assumptions.
- The economic environment and the internal management of manufacturing firms are subject to rapid and unpredictable change, making projection dangerous in any case. In the present analysis, added difficulty is presented by the need to predict which firms will survive the stress of paying for secondary treatment in 1977, but will not survive additional cost burdens in 1983 and 1985.

Consequently, the resulting estimates of manufacturing impact should be interpreted as "ballpark figures," useful primarily for providing a stimulus and a framework for further research.

Because the impact estimates are so rough, they are not presented alternative-by-alternative or town-by-town. The methodology is not sufficiently precise to generate reliable quantitative comparisons among wastewater management alternatives, although variation in costs would be likely to change the number of firms able to survive. Similarly, it is not possible to specify the number of jobs each town would be likely to lose, since the reliance on assumptions about percent changes is only relevant at a substantial level of aggregation.

Before entering into a detailed description of the methodology and the results, it is important to emphasize that the extent of impact on manufacturing employment will be determined substantially by public policy. Programs presently exist to assist firms hard pressed by water pollution requirements, through low interest loans and other measures. It is likely that the public demand for such programs will increase when the public becomes more aware of the need for short-term government

assistance to small firms threatened by the high cost of pollution control. Improved or expanded adjustment assistance programs would render any previous estimates of manufacturing impact invalid, since many firms expected to be in serious trouble would then be able to survive.

Cost Estimation

This section will discuss the costs which industry will have to bear under advanced wastewater management. The subsequent section will use this cost information to estimate the potential employment impact on area firms.

The cost estimation deals separately with the operating and construction costs. Operating costs had been estimated for the Merrimack study on a per thousand gallon basis. Since there are significant economies of scale in plant operation, cost estimates were made for 1, 10, and 100 million gallons per day (MGD) plants. The figures for the 10 MGD plants were selected for present purposes, since this plant scale is closest to the scales of the plants planned for the areas with most of the manufacturing activity. The operating costs for the land and water based alternatives were presented separately.

Anderson-Nichols and Company provided data on the total construction costs (including collection systems, treatment plants, etc.) of each alternative in both regions. For present purposes the costs of the four water and two land oriented alternatives were averaged. These figures were increased 30% to account for interest charges and administrative overhead; this is consistent with the Corps of Engineers' procedure for adding 30% to all "engineering" construction costs estimates. Rather than figure precisely the cost of the treatment systems in each year between the present and the end of the planning period, the rough assumption was made that the construction costs would be paid in 20 equal annual payments. The costs of the secondary facilities (1977) and the advanced facilities (1983 and 1985)* were figured separately, and divided by the Anderson-Nichols estimates of total regional flow for those years. 1985 flows were estimated on the basis of 1977 and 1990 flow data, assuming a straight line increase.

The assumption behind such calculations of cost per flow is that the share of the construction cost borne by each user of the treatment facilities would be determined by that user's flow of waste discharge. While this is the most reasonable assumption which can be made for present purposes, it should be borne in mind that the

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*We have assumed for simplicity that this cost increase will occur all in 1985. To the extent that some small part of the AWT cost will be incurred in 1983, the difficulty of adjustment by firms will be overstated.

particular methods by which user charges are to be calculated have not yet been finalized. Finally, since industry can be repaid for 25% of its share of construction costs, these construction costs were reduced accordingly.

The unit construction cost estimates were added to the operating costs discussed above. These total costs could then be applied to data on the discharge from manufacturing firms to yield estimates of the annual costs to these firms of using the municipal sewer system in 1977 and 1985. Since pre-treatment for compatibility with municipal effluent is required for manufacturing firms, an estimate of the unit cost of pre-treatment was also made. The need for pre-treatment varies widely among industries and firms, and it was beyond the scope of this study to make accurate estimates of pre-treatment costs; here, these costs were estimated to be about half of the unit cost for secondary treatment, or 10 cents per thousand gallons.

Tables 60 and 61 present the unit costs of treatment for the two RPA regions. The baseline (1977) costs are presented along with the additional and total AWT costs for the land and water oriented alternatives. Given the roughness of the impact estimation process, the differences between the alternatives were not considered great enough to justify impact comparisons among alternatives. For the purposes of the impact assessment, the average of the four water-oriented alternatives was used.

Firm Categorization and Impact Assumptions

The manufacturing firms in the two regions were categorized into seven groups so that different assumptions about employment impacts could be specified for each group. Table 62 presents the data and assumptions for these groups. The "Industrial Waste Summaries" provided employment and discharge data on 268 firms, and these were categorized into Groups II through VII. These firms were concentrated in the heavy water using industries: food (SIC 20), textiles (SIC 22), paper (SIC 26), chemicals (SIC 28), leather (SIC 31) and fabricated metal products (SIC 34). The firms for which no data were presented in this summary were assumed to generate waste "primarily comprised of sanitary water."

These 509 firms -- with 21,021 employees -- were categorized into Group I. For these firms in Group I, no pre-treatment would be required, and discharges would be at a relatively low rate. We have thus assumed that none of the firms in this group would be subject to substantial treatment cost burdens, and that they would encounter no

adverse employment impact in 1977 or 1985. The number of firms and employees in Group I was figured by subtracting the firm and job totals on summary sheets from employment totals for the two regions taken from the data compiled by the Massachusetts Department of Commerce and Development. This procedure underestimates the size of this group to the extent that industrial growth had taken place since 1970.

Groups II and III include firms which were in heavy water using industries identified by the engineers, but which used relatively small amounts of water and were thus assumed to be in little danger of adverse employment impact. Group II includes 98 firms with 5,428 employees; these firms use only sanitary water, and the same considerations apply to them as to Group I firms. We thus assumed no loss of jobs here. Group III includes 66 firms with 3,145 employees; these firms do use "process water" as well as sanitary water, but their discharge flows are very small. Firms were included in Group III if their process water discharge was 5,000 gallons per day or less. The highest dischargers in this group would thus be expected to pay about $400 per year in 1977 and $900 per year in 1985. We expect that all of these firms would be able to pass on these costs without difficulty, but we have assumed a maximum one percent employment decline for 1977 and the same for 1985. Table 62 presents the detailed data on these impacts for all manufacturing groups.

The discharge and employment data for the remaining firms not yet categorized from the summary sheets were examined to see which ones appeared to have the highest and lowest "relative" discharges. From this examination, 16 firms were found which were very large companies as judged from their employment figures, but which discharged relatively little wastewater. These 16 firms with a total of 16,602 employees were categorized as Group IV and assumed to be in no danger of employment problems.

On the other hand, other firms were identified that had extremely high discharge levels but were rather small in size. The 1977 and 1985 treatment costs calculated for these firms appeared to be sufficiently high to assure that these firms would all have serious short-term difficulties finding ways to pay for the required treatment, before costs are fully embodied in price increases to consumers. Conversations with local planning personnel and Chamber of Commerce representatives generally supported this assessment, and we finally assumed that, whatever job loss occurs, half of the jobs in these firms would be lost in 1977 and the rest in 1985.

TABLE 60

Treatment Costs in Dollars Per 1,000 Gallons of Wastewater:
Merrimack Valley Planning Commission

Secondary Treatment, 1977	
Operations and Maintenance	$ .085
Construction	$ .933
Pre-Treatment	$ .100
Total	$ .287

	Advanced Wastewater Management Alternatives	
	Water-Oriented (1-4)	Land Oriented (5 and 6)
Additional Costs to be Incurred in 1983 and 1985		
Operations and Maintenance	$.216	$.055
Construction	.083	.093
Total	.299	.148
Total Costs as of 1985	$.586	$.435

TABLE 61

Treatment Costs in Dollars Per 1,000 Gallons of Wastewater:
Northern Middlesex Area Commission

Secondary Treatment, 1977	
Operations and Maintenance	$ .085
Construction	$ .074
Pre-Treatment	$ .100
Total	$ .269

	Advanced Wastewater Management Alternatives	
	Water-Oriented (1-4)	Land-Oriented (5)
Additional Costs to be Incurred in 1983 and 1985		
Operations and Maintenance	$.216	$.055
Construction	.185	.259
Total	.401	.314
Total Costs as of 1985	$.670	$.583

TABLE 62

Categorization of Manufacturing Firms

Group	MVPC Number of:		NMAC Number of:		Description	Employment Impact Assumption % Job Loss	
	Firms	Jobs	Firms	Jobs		1977	1985
I	314	9,477	195	11,544	No discharge data	0	0
II	69	3,608	29	1,820	Sanitary discharge only	0	0
III	34	2,175	32	970	Less than 5,000 gallon/day discharge	1	1
IV	12	13,552	4	3,050	Low discharge burden with respect to firm size	0	0
V	5	562	3	391	High discharge burden	50	100
VI	5	9,669	2	1,200	Firms with over 400 jobs not categorized above	0	0
VII	51	3,335	22	2,522	Remaining firms with discharge over 5,000 gallons/day	10	10
TOTALS	490	42,378	287	21,497			

There were 7 firms remaining on the summary sheets which employed a total of more than 400 persons. The annual treatment costs were projected for these firms, and they were discussed with local planners and businessmen. None of these firms appeared to be in serious danger, and we thus assumed no employment impact. These 7 firms, with 10,669 employees, were categorized as Group VI.

There were 73 firms left after the rest were categorized, and there was no way to single out some of these for special analysis. Average employment in these firms was 80, and the average discharge level was 63,000 gallons per day. The total annual treatment cost estimated for the average firm in this group was $4,600 with secondary treatment (1977) and $1,300 with advanced wastewater treatment (1983-1985). On the basis of our conversations with local planners and businessmen, estimates were made of the percentage of these firms which would be forced to close or severely cut back operations in 1977 and 1985. It should be noted that the people we contacted provided a highly divergent range of estimates of the percent of Group VII jobs they expected to be lost. Based on a rough average of these estimates, assumptions made were that 10% of the existing Group VII employment would be lost when the 1977 user charges come into effect, and that 10% of the remaining jobs would be lost in 1985. These estimates were made as maximum expected impacts, not necessarily the impacts which we would actually expect to take place.

The assumption is made here that employment in each of the groups will increase at 2% a year. This is likely to be a high estimate for the Merrimack Valley Planning Commission and a low estimate for the Northern Middlesex Area on the basis of past employment growth. The employment levels for the manufacturing sector in 1960 and 1970, with the percent change over the period, is presented in Table 63. A 2% rate of increase per year for ten years results in a 25% increase over the period.

The assumptions presented above concerning employment impact in the seven groups were applied to current employment data for the groups, and employment in 1990 was calculated with and without AWT. This was done at the RPA level of aggregation.

TABLE 63

Data on Manufacturing Employment

	MVPC	NMAC	TOTAL
1960	40,629	25,049	65,678
1970	40,499	31,781	72,280
Percent change	-0.3	+26.9	+10.1

Summary of Manufacturing Impacts

Our assessment of the impacts expected on the manufacturing sector has emphasized employment impacts. Estimates of the maximum number of jobs which could be lost in each RPA region as a result of the difficulties faced by firms in absorbing the sudden increase in treatment costs to which they will be subject in 1983 and 1985 are presented in Tables 64 and 65. These estimates have been based upon the assumptions specified above and are subject to the limitations discussed above.

Merrimack Valley

The assumptions of our methodology yield an estimate of a maximum of 827 manufacturing jobs lost as compared to the baseline by 1990. This amounts to a 1.4 percent reduction from the baseline. Although no further impact would take place after 1990, economic growth of 2 percent would increase the difference between the baseline and AWT conditions to 1,498 jobs by 2020 (still 1.4 percent less than the baseline). If it were assumed that no such growth were to take place, and that no changes in employment other than the AWT impacts occur, a maximum of 603 jobs would be lost by 1990, and no further changes from the baseline would occur. This would still represent a 1.4 percent change.

Northern Middlesex

For the Northern Middlesex Area we estimate a maximum of 594 manufacturing jobs lost in 1990, or a 2.1 percent reduction from the baseline. The difference would increase with growth to 1,076 jobs in 2020. If no growth were assumed, a maximum of 432 jobs might be lost by 1990, with no further changes from the baseline in 2020. This maximum job loss would still be a 2.1 percent change from the baseline.

TABLE 64: MAXIMUM POTENTIAL IMPACT* ON MANUFACTURING EMPLOYMENT

Geographic Area: Merrimack Valley Planning Commission

Impact: Capital Cost Funding, Private Abatement Actions, and Operations/Manufacturing

The increased cost of wastewater treatment to manufacturing firms due to capital cost funding of facilities, pretreatment requirements, and funding of facilities operations will cause some firms in the region to curtail or cease operations. (Note: a uniform 2% increase in manufacturing employment per year was assumed in these calculations.)

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Number of manufacturing sector jobs	57,302 jobs		103,791 jobs	
Alternatives 1-6	Number of manufacturing sector jobs	56,475 jobs	827 jobs lost (or 1.4% of baseline)	102,293 jobs	1498 jobs lost (or 1.4% of baseline)

*The employment impact data shown in this table differ from the data shown for other impact categories in that these estimates reflect the maximum rather than the expected changes. These data are subject to the limitations specified on page 132 above.

TABLE 65: MAXIMUM POTENTIAL IMPACT* ON MANUFACTURING EMPLOYMENT

Geographic Area: Northern Middlesex Area Commission

Impact: Capital Cost Funding, Private Abatement Actions, and Operations/Manufacturing

The increased cost of wastewater treatment to manufacturing firms due to capital cost funding of facilities, pretreatment requirements, and funding of facilities operations will cause some firms in the region to curtail or cease operations. (Note: a uniform 2% increase in manufacturing employment per year was assumed in these calculations.)

Plan Actions	Indicators of Impact	Short Term Situation (1990)	Change from Baseline	Long Term Situation (2020)	Change From Baseline
Baseline (EPA State Implementation Plan)	Number of manufacturing sector jobs	28,879 jobs		52,309 jobs	
Alternatives 1-5	Number of manufacturing sector jobs	28,285 jobs	594 jobs lost (or 2.1% of baseline)	51,233 jobs	1076 jobs lost (or 2.1% of baseline)

*The employment impact data shown in this table differ from the data shown for other impact categories in that these estimates reflect the maximum rather than the expected changes. These data are subject to the limitations specified on page 133 above.

DATA SOURCES

(Manufacturing)

(1) Anderson-Nichols and Company, Inc., Appendix One to the Merrimack Wastewater Management Study; especially (1) Chapter III, "Quantity and Quality of Wastewater Flow" of Section E, Water Supply and Management", (2) "Industrial Waste Summaries," and (3) "Industrial Listings."

(2) Charles River Associates, Economic Impact of Environmental Control and Management in New England, Report No. 128-1 May 1969 (reproduced as Pollution Control and Management, National Technical Information Service, No. COM-71-00061, Oct. 1969)

(3) Massachusetts Department of Commerce and Development, Data on "No. of Local Firms by Industry" and "Employment of Firms in Locality," 1970, for Northern Middlesex and Merrimack Valley areas.

(4) U. S. Army Corps of Engineers, Alternatives for Merrimack Wastewater Management, Information packets for mid-stage public meetings, for NMAC and MVPC, April, 1974.

(5) U. S. Department of the Interior, Federal Water Pollution Control Administration, The Cost of Clean Water, November 1967.

(6) U. S. Environmental Protection Agency, Office of Water Program Operations, Pretreatment of Pollutants Introduced into Publically Owned Treatment Works: Federal Guidelines, Ocrober 1973.

I. IMPACT CATEGORY: EMPLOYMENT

The plan actions of proposed engineering alternatives that will have direct impacts on employment in the study area are (1) the short-term construction activities and (2) the long-term operations and maintenance activities. (Other indirect impacts on employment that are expected to occur in the manufacturing sector are discussed in the section preceding this one.

Construction

Because advanced wastewater treatment systems are a relatively recent development, there does not yet exist a reliable body of published data on the manpower requirements of constructing and operating systems of the scale proposed in the present study. In the case of treatment plant construction, data supplied by engineers consisted of man-month estimates for construction of plants handling 1, 10 and 100 millions of gallons of wastewater flow daily. These employment estimates were plotted against plant capacity, and a crude line drawn between these three data points. Flow data for each plant were converted into manpower requirements and summed for each alternative. Total man-months for each alternative were then converted into full-time equivalent workers by dividing by 12, on the assumption that treatment plant construction will proceed a full twelve months of the year.

Manpower requirements for pipeline construction (incorporating gravity interceptors, force mains, pumping stations and outfalls) were estimated on the basis of 30 man-months required for each mile of pipeline. (Miles of pipeline were determined from pipeline costs, which were estimated to be approximately $250,000 per mile in 1974 dollars.) This method was applied in estimating employment from both pipeline facilities associated with the engineering alternatives for advanced wastewater treatment (AWT) proposed by the Corps of Engineers, and the municipal collection systems that will be needed but which are not part of the Corps proposals. Employment man-months, in the case of pipelines, were divided by 9 to obtain full-time equivalent worker estimates since this type of construction does not normally continue through the winter months.

The resulting manpower estimates shown in the charts below for the Merrimack Valley and Northern Middlesex regions are disaggregated into different components of construction; the totals that exclude

collection systems represent the employment that would be generated by the Corps of Engineers' AWT Alternatives, which are the subject of the present study. Estimated manpower requirements for municipal collection systems are also included in order to give an idea of the total employment that would actually be involved in implementing the entire wastewater management system.

Three important points should be considered in connection with the estimates presented here. First, several towns in the study area have collection systems that are already, or are soon to be, in place; the cost and manpower requirements of constructing these systems have not yet been subtracted from the estimates shown here. Second, it was not possible to present a comparison between the manpower requirements of the study baseline -- the EPA State Implementation Plan -- and the AWT alternatives, since treatment plant flow data and pipeline cost data were compiled in separate studies in separate forms.

The third point to be considered concerns the proportion of total construction manpower that will be drawn from the study area. The ratio of workers who will be hired from inside the study area to those who will be hired from other areas, will depend chiefly on whether or not the construction contractor is a local firm. If, as is likely, the contractor is a Massachusetts firm based outside the study area, it is assumed that approximately 50% of the workers would be hired from inside and 50% from outside the study area. It is not anticipated, however, that a large influx of non-resident workers would have a significant impact on local municipal services, since workers from outside the area would likely be coming from either southern New Hampshire or metropolitan Boston, and would hence be commuting daily into the study area, rather than moving into the area for the duration of the construction period.

Given the fluctuating nature of construction employment, it is almost certain that some of the workers to be hired will be currently unemployed or underemployed. For the purposes of allocating impacts in terms of the Water Resources Council's Objectives for Planning Water and Related Land Resources, the employment of previously unemployed or underemployed labor resources should be measured not only as a benefit to the objectives of Regional Economic Development and Social Well-Being, but National Economic Development as well.*

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* See Section F. BENEFICIAL EFFECTS ON NATIONAL ECONOMIC DEVELOPMENT, in Water Resources Council, Water and Related Land Resources: Establishment of Principles and Standards for Planning, Federal Register, Vol. 38, No. 174, Part III, September 10, 1973.

Operations and Maintenance

Calculations of the estimated manpower required for operating treatment facilities under each AWT alternative are based on data presented in "Resource Requirements", of Appendix III, Volume 1. Hence, the same qualifications regarding the accuracy of those estimates applies to the numbers presented here -- notably, that they are based upon incomplete published data on general AWT plant operations, which furthermore, have been necessarily adjusted to the particular scales of the proposed facilities. Our procedure for estimating operations and maintenance manpower requirements for each alternative was similar to that used in deriving the estimates for pipeline construction. (Engineer's estimates of annual man-hour requirements for treatment plants handling 1, 10 and 100 millions of gallons of wastewater daily were plotted against plant capacity and a crude line drawn between these three data points. Flow data for 1990 and 2020 for each plant were converted into manpower requirements for each alternative). Total annual man-hours needed per alternative were divided by 2,000 (50 weeks x 40 hours/week) to obtain the estimated number of full-time equivalent employees required under each alternative. Clearly, not all operations and maintenance personnel will be full-time workers; however, it was not possible here to predict the probable breakdown of full-time and part-time employment. Estimates of the numbers of full-time equivalent employees that will be required by region under each of the AWT alternatives are displayed in the following chart. Here again, it was not possible to compare the AWT employment requirements with corresponding figures for the baseline since comparable flow projections for the EPA State Program facilities were not available. We are therefore limited to displaying differences across the AWT alternatives only.

TABLE 66: ESTIMATED CONSTRUCTION EMPLOYMENT

Merrimack Valley Planning Commission

Alternative	Full-Time Equivalent Manpower Requirements				
	Treatment Plant Construction	Pipeline Construction	Total Employment Excluding Collection System	Municipal Collection System Construction	Total Employment Including Collection System
1	390	395/458*	785/848*	1,266	2,051/2,114*
2	371	481	852	1,261	2,113
3	421	778	1,199	1,247	2,446
4	427	778	1,205	1,247	2,452
5	369	590/626*	959/995*	1,272	2,231,2,267*
6	369	593/629*	962/998*	1,272	2,234/2,270*

* The lower figure is based on construction of an estuary outfall, and the larger figure on construction of an ocean outfall.

Alternative	Estimated Local Employment (50% of Total)				
	Treatment Plant Construction	Pipeline Construction	Total Employment Excluding Collection System	Municipal Collection System Construction	Total Employment Including Collection System
1	195	195/229	393/424	633	1,026/1,057
2	186	241	426	631	1,057
3	211	389	600	624	1,223
4	214	389	603	624	1,226
5	185	295/313	481/498	636	1,116/1,134
6	185	297/315	481/499	636	1,117/1,135

TABLE 67: ESTIMATED CONSTRUCTION EMPLOYMENT

Northern Middlesex Area Commission

Alternative	Full-Time Equivalent Manpower Requirements				
	Treatment Plant Construction	Pipeline Construction	Total Employment Excluding Collection System	Municipal Collection System Construction	Total Employment Including Collection System
1	307	366	673	1,320	1,993
2	337	1,104	1,441	1,288	2,729
3	278	1,458	1,736	1,721	3,457
4	199	1,654	1,853	1,308	3,161
5	285	1,268	1,553	1,326	2,879

Alternative	Estimated Local Employment (50% of Total)				
	Treatment Plant Construction	Pipeline Construction	Total Employment Excluding Collection System	Municipal Collection System Construction	Total Employment Including Collection System
1	154	183	337	660	997
2	169	552	721	644	1,365
3	139	729	868	861	1,729
4	100	827	927	654	1,581
5	143	684	777	663	1,440

TABLE 68: ESTIMATED OPERATIONS AND MAINTENANCE EMPLOYMENT

Merrimack Valley Planning Commission

Alternative	Full-Time Equivalent Manpower Requirements	
	Short-Term (1990)	Long-Term (2020)
1	258	350
2	254	330
3	286	372
4	358	424
5	217	293
6	217	293

Northern Middlesex Area Commission

Alternative	Full-Time Equivalent Manpower Requirements	
	Short-Term (1990)	Long-Term (2020)
1	192	290
2	196	288
3	176	256
4	64	96
5	87	138

J. IMPACT CATEGORY: PERSONAL INCOME AND WEALTH

The major ways in which the personal income and wealth of basin residents will be affected by implementation of wastewater management systems are through changes in property values; wages paid to construction and operations employees; taxes and/or user charges levied to pay for treatment systems; and multiplier effects of service sector impacts. These changes will take place in connection with the following plan actions of proposed engineering alternatives: Water Quality Objectives; Construction; Land Modification; Capital Cost Funding; Private Abatement Actions; and Operations.

Water Quality Objectives

Improvement of surface water quality in the study area is expected to increase personal income and wealth through enhancement of property values in areas adjacent to the Merrimack River and associated streams, and also through the multiplier effects of increased service sector profits and employment stemming from the recreation benefits of improved water quality.

Property values tend to respond to the laws of supply and demand in the classic manner. At present, the demand for waterfront property along the Merrimack River is weak, but the demand will increase with improvements in water quality, and in some cases that increase may be reasonably expected to be dramatic. There is a finite amount of waterfront acreage, and particularly in the case of advanced wastewater treatment (where swimming will become possible, and any fish caught will be edible), the price of waterfront property will increase substantially. To the extent that some of the land is reserved for public parks and other facilities, the price of remaining waterfront land available for private ownership will increase that much more. Land available to private use that is near the river (although not on the waterfront but from which the river is easily accessible) will also increase in value. In sum, as waterfront property (or property close to the waterfront) becomes more desirable because of improvement in water quality, the demand for such land will substantially increase, thus driving property values up.

In an earlier section of this report, it was estimated that with AWT, the demand for swimming (as measured by number of activity days) would more than double. The demand for associated recreational activities would increase as well. Such increases in the demand for recreation can be expected to induce an increased demand for services in

the local economy, primarily the provision of food and lodging, and rental of recreational equipment (e.g., boats). The increased demand for services will in turn, increase the demand for service sector personnel. This increased business activity and employment in the local service sector will have a multiplier effect on the local economy, thereby creating additional local income.

Construction

Direct, short-term benefits on personal income and wealth will occur through the wages paid to construction workers hired from within the study area. To give a rough idea of the magnitude of the impact, it is assumed that approximately 50% of total construction manpower will be drawn from the study area, and that the average wage rate paid will be approximately $9.30/hour in 1974 dollars. (Estimated construction manpower requirements are presented in the chapter on Employment.) Minor indirect benefits on personal income and wealth will be generated by the multiplier effects of construction wages paid, and of service sector benefits resulting from local purchases of construction materials and expenditures made by non-resident construction workers.

Land Modification

The impacts of water quality improvements on personal income and wealth cited above are dependent on a particular pattern of land use. Changes in that pattern will produce concomitant changes in property values and service sector impacts. For example, to the extent that riverfront land is reserved for public parks and recreational facilities, the prices of the remaining riverfront and adjacent land will rise because of its increasing relative scarcity, and vice-versa. To the extent that the land remains in industrial uses, its value will not rise as much as if full advantage could be taken of its recreational potential. In addition, land values along the river are unlikely to increase homogeneously. The value of land that is located near visually unpleasing water treatment facilities or industrial plants will appreciate less than that of land located near parks or recreational facilities. Further, land which is located at the crossroads of public highways or main roads will appreciate more than land not so well situated, because of the commercial potential of building service sector establishments (e.g., restaurants) on those parcels.

Capital Cost and Operations Funding

The construction costs of municipal wastewater treatment systems are eligible for 75% federal and 15% state subsidy, leaving municipalities responsible for the remaining 10% of the total costs.

Local industries are expected to be charged for their share of that 10%, and the non-industrial portion may be recovered either through general tax levies or direct user charges, or some combination of these. It has been recommended in the Institutional Arrangements section of this study (Appendix V) that municipalities' bonded debt for construction be repaid through a system of user charges, with a provision for ultimate recourse to the tax base in order to assure the marketability of bonds. It is consequently expected that in terms of the impacts on personal income and wealth, it will be the actual users of proposed systems who will be assessed for the local share of construction.

Private Abatement Actions

Increasing operating costs of manufacturing firms resulting from investments in pollution abatement (pretreatment and/or share of municipal treatment costs) will likely be passed on to consumers in the form of higher prices, thereby reducing the disposable income of these firms' customers. The costs of industrial abatement are expected to cause some firms in the study area to cut back substantially on production or in some cases even go out of business, hence producing employment losses. Any loss of jobs will, in the short term, cause some reduction in the personal income and wealth of the employees affected.

Operations

Direct effects of treatment system operations on the personal income and wealth of study area residents will occur through the user charges levied to finance operating and maintenance costs and the wages paid to O & M personnel. The magnitude of these impacts will depend on the engineering alternative selected: The secondary wastewater treatment systems proposed by the EPA State Program have the lowest operating costs, while among the advanced treatment alternatives, the land-oriented proposals are significantly less costly to operate than are the water-oriented proposals.

As to the positive impact of wages paid to O & M personnel, engineers have assumed in calculating operations costs an average wage rate of $5.50 per hour. Rough estimates of the numbers of employees that would be required under each alternative are presented in the chapter on Employment.

Minor indirect impacts of operations will occur in the form of multiplier effects of sales of chemicals and power used in operating treatment systems.

K. IMPACT CATEGORY: MUNICIPAL FINANCE

One of the most immediate and direct impacts of implementing any of the proposed engineering alternatives will be that on local municipal finances. The two plan actions involved, Capital Cost Funding and Operatings Funding, will both ultimately affect local tax rates and hence personal income. Paying for the local share of the construction costs will require an increase in the level of bonded debt and be reflected in higher annual charges for debt service. Operating the new plants will mean higher annual operations and maintenance costs. The precise magnitude of the impact on tax rates will depend on the means used to pay for the non-industrial portion of construction costs. It will be lower if these costs are recovered through user charges rather than being placed directly on the tax base.

Tables 69-73provided on the following pages show for each of the RPAs:

- the total construction costs for the six initial engineering alternatives;
- the local non-industrial portion of construction costs for each of the six initial engineering alternatives, by town;
- the annual principal and interest costs on the bonded debt, for both the low and high cost options among the six alternatives, by town;

Table 74 displays total O&M costs for these six engineering alternatives, while Tables 75 and 76 show expected annual O&M costs, by town, for the hybrid "least-cost" alternative. Finally, Tables 77-80 show the municipal finance impacts associated with the preferred engineering alternative ultimately selected by the study team. Tables 77 and 78 show, by town, the expected increase in the current tax rates due to the local, non-industrial portion of construction costs. Tables 79 and 80 show the associated annual O&M costs. For both construction and O&M, the municipal finance impacts are broken out separately for 1977, 1883, and 1985.

A number of methodological notes are needed in order to explain the origin of these figures and to place them in proper perspective:

- For the analysis of the six initial engineering alternatives, estimates of construction for an individual town for 1977, 1983, and 1985 were simply added together rather than discounted separately back to the present. By not discounting we overstated the present costs of future construction and hence overstated the size of the needed bond issue. This procedure was not followed for the analysis of the preferred alternative. There the three cost streams were discounted back to the present separately.

- Construction costs for municipal collection systems were assumed not to be eligible for federal-state cost-sharing. Technically such costs are eligible but given current federal appropriations and spending priorities, reimbursement is unlikely.

- The industrial portion of local construction costs (less collection systems) were excluded for purposes of calculating federal-state reimbursement. These costs are subject to full recovery through charges on the industries involved. Industrial costs were separated out on the basis of average industrial flows as a percentage of average total flows for each town.

- Real estate costs were included as eligible for reimbursement. These were allocated among towns on the same basis as were construction costs.

- Certain portions of the EPA-State Implementation Plan have already been bid and the requisite local financing arranged. For the analysis of the initial six engineering alternatives, these "sunk" costs were not credited to the towns involved, and hence the resulting town costs overstate the construction cost burden. In the analysis of the preferred engineering alternative these sunk costs were subtracted out and the projected tax rate increases thus are more realistic.

- The reimbursement formula for capital costs was assumed to be 75% federal and 15% state, consistent with the 1972 Amendments to the FWCPA. Full collection system costs were then added back into the 10% local share to arrive at the total capital cost burden for the individual community.

- For the analysis of the six initial engineering alternatives, annual principal and interest costs for the indicated local burden were computed assuming a bond issue for 20 years at 5.80%. The financial assumptions underlying the analysis of the preferred engineering alternative were modified somewhat. An interest rate of 6.00% was assumed. The amortization period was assumed to be 30 years for the 1977 facilities, 20 years for the 1983 and 1985 facilities.

The procedure actually employed to calculate the 1977, 1983 and 1985 tax rate impacts of the preferred engineering alternative is thus fairly straightforward. It is spelled out in a stepwise fashion below.

1. Cities and towns must pay for 10% of all eligible costs associated with the 1973, 1983 and 1985 construction. Eligible costs under the 1972 FWPCA Amendments are defined broadly and include almost all facilities and land costs, except for local collection systems. To the municipality's share of eligible costs for each time period is added 100% of all ineligible costs, principally collection system costs.

2. From these town totals for 1977, the eligible portion of all "sunk" costs associated with existing facilities built to meet the 1977 requirements were deducted. Deducted from town totals for 1977, 1983 and 1985 were the industrial portion of the 75% federal construction subsidy due under the industrial cost recovery provisions of the Act.

3. The resulting net total costs to each town for the three time periods were then translated into annual principal and interest charges, assuming a bond interest rate of 6.00% over 30 years for the 1977 facilities and 20 years for the 1983 and 1985 facilities.

4. The actual principal and interest burden which falls directly upon the city or town is then computed by separating out the industrial portion of these last totals. Industrial costs are assumed to be proportional to the industrial component of 1990 average total flows for the individual municipality.

5. The resulting municipal burdens for annual principal and interest costs, for each of the three time periods, is then divided by the 1973 assessed valuation for that city or town. Expressed in $/thousand $ of assessed valuation, this figure is then added to the municipality's 1973 property tax rate to come up with the desired tax rate increase figures.

These calculations are presented in Table 77 (Merrimack Valley Planning Commission) and Table 78 (Northern Middlesex Area Commission).

The key to interpreting the tax rate impacts of the preferred engineering alternative (Tables 77, 78)is an understanding of how the sewerage costs were handled. First, local collection systems are not eligible for federal and state construction subsidies and hence have to be paid entirely by the municipality. The substantial tax rate increases shown for towns such as Newbury, Georgetown, Merrimac, Billerica and Dracut are largely due to the fact that these towns will be required to invest heavily in new sewerage systems. Given that there is no local industry to help share its sewerage costs, Newbury's tax rate would increase by 73% by 1985. The 1985 increases for Georgetown, Merrimack, Billerica and Dracut average 18%, the principal reason for the difference with Newbury being that these four towns have a considerable industrial base over which to spread the cost. Second, the bulk of the tax rate impact for all towns shows up under 1977 program costs. This is somewhat artificial in that it assumes that local collection systems will be built up to 1990 service area boundaries right at the start rather than gradually over time as the town develops. A more realistic interpretation of Tables 77and 78 would push back some of the 1977 tax rate increases and spread them over the period of the 1980s. Since individual town growth rates are nearly impossible to forecast, some accounting convention was required and the engineers chose to show the sewerage costs as early on as possible.

This study did not examine the financial capacity of the individual Merrimack Valley and Northern Middlesex communities to determine how great a hardship these fiscal impacts would work on local government operations and services. For most of the communities the tax rate impact of construction costs would not appear to create severe problems. For a town such as Newbury perhaps special action will be required, such as treating its sewerage system as an eligible cost under the FWPCA construction grant program.

The annual O&M cost burden on individual towns cannot be met through recourse to the local tax base according to a recent federal ruling. O&M costs must be paid through a system of user charges

whereby each type of user pays his proportionate share according to how his discharge (volume, strength, timing) affects treatment costs. Tables 79 and 80 display that portion of a town's O&M costs which non-industrial users will have to pay. Clearly, Lowell, Haverill and Lawrence will be paying substantial annual amounts, in excess of $1 million dollars by 1985. But the severity of the fiscal impact on individual towns can only be fully measured by how much these dollar amounts represent in terms of an increase over current operating costs. These additional data were not gathered as a part of this study.

TABLE 69

Total Construction Costs
by Alternative and Planning Area

($ Millions)

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Merrimack Valley Planning Commission*	252	222	234	229	232	233
Northern Middlesex Area Commission	205	211	238	234	247	247
Totals	$457	$433	$472	$463	$479	$480

*All MVPC figures assume an ocean outfall.

TABLE 70

Merrimack Valley Planning Commission
Total Capital Costs
(1977, 1983 and 1985 together)

	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
Amesbury	4,223,869	4,280,259	3,583,384	3,583,384	4,181,860	4,181,870
Andover	19,386,041	19,388,384	18,369,462	19,328,582	19,382,741	19,382,741
Boxford	17,000	17,000	125,100	125,600	14,200	17,000
Georgetown	79,400	79,400	131,500	132,000	0	0
Groveland	8,382,037	8,382,037	8,578,619	8,582,167	9,042,612	9,042,612
Haverhill	31,321,154	31,342,574	31,669,835	31,490,015	32,447,571	32,484,746
Lawrence	11,703,889	11,707,071	11,597,903	11,492,123	11,703,889	11,703,889
Merrimac	3,455,930	3,090,969	3,108,432	3,108,432	3,644,153	3,820,004
Methuen	5,729,826	5,716,856	5,668,037	5,661,224	5,729,826	5,729,826
Newbury	6,345,087*	6,376,297*	6,091,027*	6,077,286*	6,259,628*	6,259,628*
Newburyport	6,212,245	6,393,680	6,536,595	6,512,204	6,253,648	6,253,648
North Andover	5,812,673	5,807,543	5,803,834	5,798,829	5,848,218	5,848,218
Rowley	0	0	159,000	159,000	0	0
Salisbury	5,227,420	5,321,820	5,650,060	5,598,259	5,500,430	5,500,430
West Newbury	81,570	109,600	66,800	66,800	0	61,000

* Estuary outfall assumed.

TABLE 71

Northern Middlesex Area Commission
Total Capital Costs
(1977, 1983 and 1985 together)

	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
Billerica	35,186,210	35,295,469	35,541,980	35,476,192	35,604,741	--
Chelmsford	6,583,754	6,641,284	5,927,327	6,222,279	7,444,774	--
Dracut	14,942,511	15,198,669	15,332,199	15,209,428	15,384,378	--
Dunstable	85,700	241,900	268,100	374,400	102,500	--
Lowell	37,290,267	35,442,412	38,429,652	37,587,325	38,665,190	--
Pepperell	4,288,090	3,405,980	3,126,100	3,126,100	4,461,120	--
Tewksbury	7,865,376	8,120,956	8,267,357	8,160,138	8,338,992	--
Tyngsborough	2,036,550	2,283,439	2,346,552	2,459,329	2,188,427	--
Westford	4,340,332	4,379,689	4,417,564	4,460,020	4,688,023	--

TABLE 72

Merrimack Valley Planning Commission

Annual Principal and Interest Costs
for Low and High Cost Alternatives

20 Year Term - 5.80%

	Low Alt.		High Alt.	
	1st yr.	2nd yr.	1st yr.	2nd yr.
Amesbury	389,000	189,000	462,000	226,000
Andover	2,087,000	1,022,000	2,094,000	1,026,000
Boxford	1,500	740	14,000	7,000
Georgetown	0	0	14,000	7,000
Groveland	905,000	443,000	975,000	478,000
Haverhill	3,383,000	1,657,000	3,508,000	1,718,000
Lawrence	1,241,000	608,000	1,265,000	619,000
Merrimac	334,000	163,000	413,000	202,000
Methuen	611,000	299,000	619,000	303,000
Newbury	657,000	322,000	689,000	338,000
Newburyport	671,000	329,000	706,000	346,000
North Andover	626,000	307,000	632,000	309,000
Rowley	0	0	17,000	8,000
Salisbury	565,000	277,000	610,000	299,000
West Newbury	0	0	12,000	6,000

TABLE 73

Northern Middlesex Area Commission

Annual Principal and Interest Costs
for Low and High Cost Alternatives

20 Year Term - 5.80%

	Low Alt.		High Alt.	
	1st yr.	2nd yr.	1st yr.	2nd yr.
Billerica	3,802,000	1,862,000	3,845,000	1,883,000
Chelmsford	640,000	314,000	806,000	394,000
Dracut	1,609,000	788,000	1,661,000	814,000
Dunstable	9,000	4,500	37,000	18,000
Lowell	3,823,000	1,873,000	4,176,000	2,046,000
Pepperell	338,000	166,000	482,000	236,000
Tewksbury	850,000	416,000	901,000	441,000
Tyngsborough	220,000	108,000	266,000	130,000
Westford	469,000	230,000	507,000	248,000

TABLE 74

Total O&M Costs
by Alternative and Planning Area

($ Millions)

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Merrimack Valley Planning Commission	6.4	6.4	6.8	6.3	5.6	5.6
Northern Middlesex Area Commission	4.8	4.8	5.0	4.6	3.4	3.4
Totals	$11.2	$11.2	$11.8	$10.9	$9.0	$9.0

TABLE 75

Merrimack Valley Planning Commission

Operations and Maintenance Costs for the "Least Cost" Alternative

	1977		1983		1985	
	O & M (1977)	O & M (1997)	O & M (1983)	O & M (1997)	O & M (1985)	O & M (1997)
Amesbury	$ 84,930	$100,051	$ 34,800	$ 42,100	$ 17,970	$ 18,470
Andover	396,020	493,333	80,640	93,740	504,570	567,270
Boxford	1,480	1,480	0	0	0	0
Georgetown	0	0	0	0	0	0
Groveland	94,910	103,100	14,850	17,350	26,290	26,610
Haverhill	514,380	609,090	170,750	199,550	144,090	147,770
Lawrence	712,460	948,890	226,560	263,380	1,353,170	1,521,320
Merrimac	33,970	37,970	1,400	1,800	24,060	27,660
Methuen	163,640	213,110	46,080	53,570	252,290	283,640
Newbury	73,300	80,390	0	0	0	0
Newburyport	123,080	153,860	0	0	0	0
North Andover	120,500	276,590	30,720	35,710	183,480	206,280
Rowley	0	0	0	0	0	0
Salisbury	92,840	109,500	0	0	0	0
West Newbury	0	0	0	0	0	0

TABLE 76

Northern Middlesex Area Commission

Operations and Maintenance Costs for the "Least Cost" Alternative

	1977		1983		1985	
	O & M (1977)	O & M (1997)	O & M (1983)	O & M (1997)	O & M (1985)	O & M (1997)
Billerica	317,360	403,520	65,550	84,830	279,800	347,900
Chelmsford	171,170	230,130	33,000	48,400	151,700	203,100
Dracut	137,750	151,380	21,700	23,800	126,400	136,100
Dunstable	11,970	11,970	0	0	3,820	3,820
Lowell	725,540	931,210	235,300	258,600	1,287,300	1,386,100
Pepperell	93,300	105,710	81,800	96,300	75,990	82,890
Tewksbury	138,030	172,520	40,200	44,200	229,100	246,700
Tyngsborough	74,130	85,360	12,400	13,600	68,500	73,700
Westford	50,780	64,440	5,200	10,000	26,500	41,600

TABLE 77

Merrimack Valley Planning Commission
Tax Rate Increases Due to the Non-Industrial
Portion of Local Share of Construction Costs
Preferred Alternative: 1977, 1983, 1985

City or Town	FY 1973 Tax Rate	FY 1977 Increase	FY 1977 New Tax Rate	FY 1983 Increase	FY 1983 New Tax Rate	FY 1985 Increase	FY 1985 New Tax Rate
Amesbury	$52.00	$0.67	$52.67	$0.05	$52.72	$1.25	$53.97
Andover	54.00	0.25	54.25	0.01	54.26	0.08	54.34
Boxford*	110.00	0.15	110.15	-0-	110.15	-0-	110.15
Georgetown*	60.00	0.26	60.26	-0-	60.26	-0-	60.26
Groveland	64.00	14.35	78.35	0.03	78.38	0.34	78.72
Haverill*	150.00	7.49	157.49	0.13	157.62	1.19	158.81
Lawrence	153.90	0.86	154.76	0.06	154.82	0.59	155.41
Merrimac	84.20	11.94	96.14	0.05	96.19	1.41	97.60
Methuen	166.00	4.93	170.93	0.07	171.00	0.63	171.63
Newbury	96.00	67.81	163.87	0.24	164.11	1.91	166.02
Newburyport	31.00	4.70	35.70	0.05	35.75	0.42	36.17
North Andover	64.00	5.86	69.86	0.04	69.90	0.37	70.27
Rowley*	58.00	-0-	58.00	-0-	58.00	-0-	58.00
Salisbury	40.00	3.37	43.37	0.09	43.46	4.62	48.08
West Newbury*	67.00	0.76	67.76	-0-	67.76	0.69	68.45

*Communities with future sewerage systems. Costs include all collection, treatment, interception, discharge and storage systems for sanitary wastewater and combined flows.

TABLE 78

Northern Middlesex Area Commission
Tax Rate Increases Due to the Non-Industrial
Portion of Local Share of Construction Costs
Preferred Alternative: 1977, 1983, 1985

City or Town	FY 1973 Tax Rate	FY 1977 Increase	FY 1977 New Tax Rate	FY 1983 Increase	FY 1983 New Tax Rate	FY 1985 Increase	FY 1985 New Tax Rate
Billerica	$205.50	$28.08	$233.58	$0.11	$233.69	$0.94	$234.63
Chelmsford	44.00	2.08	46.08	0.03	46.11	0.25	46.36
Dracut	162.00	29.55	191.55	0.07	191.62	0.60	192.22
Dunstable*	180.00	3.22	183.22	-0-	183.22	0.82	184.04
Lowell	147.40	4.89	152.29	0.15	152.44	1.17	153.61
Pepperell	64.00	2.36	66.36	0.06	66.42	0.63	67.05
Tewksbury	32.00	0.57	32.57	0.01	32.58	0.09	32.67
Tyngsborough*	44.00	8.76	48.76	0.27	49.03	0.21	49.24
Westford	53.50	4.19	57.69	0.02	57.71	0.23	57.93

*Communities with future sewerage systems. Costs include all collection, treatment, interception, discharge and storage systems for sanitary wastewater and combined flows.

TABLE 79

Merrimack Valley Planning Commission
Non-Industrial Local Share of O&M Costs
Preferred Alternative: 1977, 1983, 1985

	Initial Year O&M Costs 1977	Initial Year O&M Costs 1983	Initial Year O&M Costs 1985
Amesbury	$67,300	$24,800	$49,200
Andover	112,100	23,400	139,700
Boxford	-0-	-0-	-0-
Georgetown	-0-	-0-	-0-
Groveland	54,400	7,900	49,300
Haverill	797,000	121,300	594,400
Lawrence	474,000	88,400	527,700
Merrimac	49,275	5,400	20,200
Methuen	137,500	38,700	211,900
Newbury	74,100	10,300	46,500
Newburyport	92,900	32,100	144,600
North Andover	68,800	17,200	102,800
Rowley	-0-	-0-	-0-
Salisbury	96,400	38,300	21,600
West Newbury	-0-	-0-	-0-

TABLE 80

Northern Middlesex Area Commission
Non-Industrial Local Share of O&M Costs
Preferred Alternative: 1977, 1983, 1985

	Initial Year O&M Costs 1977	Initial Year O&M Costs 1983	Initial Year O&M Costs 1985
Billerica	$254,700	$45,300	$192,200
Chelmsford	206,500	31,400	143,500
Dracut	101,500	16,700	97,300
Dunstable	-0-	-0-	-0-
Lowell	1,179,100	197,700	1,081,300
Pepperell	26,100	17,200	11,100
Tewksbury	74,600	21,700	123,700
Tyngsborough	36,400	7,700	49,200
Westford	40,600	4,200	21,200

DATA SOURCES

(1) Construction and Operation and Maintenance Cost Summary, Merrimack Wastewater Management Study, Anderson-Nichols and Company, Inc.

(2) 1977, 1983 and 1985 Program Costs, Anderson-Nichols Inc.

(3) Debt Service Schedules, Municipal Securities Department, First National Bank of Boston, 1970.

(4) Valuable counsel on typical bond terms and rates supplied by Ropes and Gray, and the Local Government Advisory Service of the First National Bank of Boston.

(5) 1973 gross assessed valuations and tax rates for the 24 study communities, supplied through the Real Estate Division, New England Division of the U.S. Army Corps of Engineers.